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Multitemporal Floristic and Phenological (Flowering) Analysis of the Shores of Lake Issaqueena, South Carolina

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by
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ABSTRACT

The floristic and phenological (flowering) study of Lake Issaqueena in Pickens County, SC, conducted by William Pamplin in 1970-1971 was reinvestigated in 2011-2012 using the Carolina Vegetative Survey (CVS) natural community sampling methods and photo documentation using a GPS-enabled camera to determine floristic and phenological changes for this site during the forty years separating these two studies. Phenological events (flowering) were recorded via photographs taken by a GPS-enabled camera on a monthly basis. Photographs were downloaded and organized by sampling date in Picasa 3 web albums and stored in a project Google website. Plants were identified using expert knowledge, existing keys and the USDA plant database. Precipitation in 1970, 2011 and 2012 was below the long-term average and this combined with higher than average air temperature impacted drought severity in the area. Comparison of phenologies indicated 269 plant species blooming in 1970-1971 compared to 203 plants blooming in 2011-2012, and 149 common plant species blooming in both study periods. The blooming period was 11 months in 2011-2012 compared to 8 months in 1970-1971. A majority of plants were blooming earlier and longer in 2011-2012 than in 1970-1971. There appears to be a phenological shift in blooming dates, but it is unclear whether this is due to climatic variation, other environmental changes in the area, or differences in data collection methods.

Keywords and abbreviations: adaptation, anthropogenic, Carolina Vegetative Survey (CVS), change, climate, environmental, vegetation dynamics.

DEDICATION

This thesis is dedicated to Evan, William, and Wylie Pamplin.

ACKNOWLEDGMENTS

Authors wish to thank Dixie Damrel, the curator of Clemson University's Herbarium for accepting and checking the collected plant samples and for her overall support. Thanks to committee members Dr. Christopher Post, Dr. Julia Sharp and Dr. Patrick McMillan. In addition, thanks to William Pamplin for her advice, support and help in the field. Financial support was provided by Clemson University, Technical Contribution No. 6018 of the Clemson University Experiment Station.

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CHAPTER ONE

Multitemporal floristic and phenological (flowering) analysis of the shores of Lake Issaqueena, South Carolina

INTRODUCTION

Ecological changes are occurring in the floristic composition of natural communities, phenology, and distribution of plant species, and these changes are often attributed to climate change and anthropogenic activity (Parmesan 2006). Accurate forecasting of how plants will respond to climatic and anthropogenic changes is complicated by spatial and temporal variation in climate and the environment, lack of long-term data, differences in field and laboratory experiments, and many other factors (Parmesan 2006; Pau et al. 2011; Wilfried et al. 2008). Floristic and phenological changes can have significant implications on agricultural production (Fuhrer 2003). Historical records of harvest dates can be used to reconstruct past climate (Chuine et al. 2004).

Phenology and climate are intimately linked (Cleland et al. 2007). Climate change can significantly impact winter chill for temperate fruit and nut production (Luedeling 2012). Global temperatures are expected to rise by up to 6° C by the end of the 21st century, compared to pre-industrial levels (IPCC 2007) and these temperatures are expected to remain unstable (Else and Atkinson 2010). Current phenological studies include walnuts (Luedeling and Gassner 2012), apples (Rana et al. 2011), apricots

(Campoy et al. 2011), pears (Guedon and Legave 2008), and many other important fruits and nuts. Long-term data are essential for sustainable crop production in the future.

Floristic studies are often used for agricultural and environmental monitoring and assessment (Ceschin et al. 2009; Mikhailova et al. 2000). Mikhailova et al. (2000) documented changes in botanical composition between native grassland (not cultivated for at least 300 years), a grazed/hay field with 4 years of annual harvest followed by 1 year of rest (periodically-cut grazed/hay field), and a yearly-cut grazed/hay field in the V.V. Alekhin Central-Chernozem Biosphere State Reserve in the Kursk region of Russia (listed in the UNESCO – MAB Biosphere Reserves directory).

Floristic analysis can be conducted in urban environments as well. Ceschin et al. (2007) reported that over 40% of species documented within an archaeological site in Rome disappeared when current floristic data was compared with historical floristic data collected in 1955 on the same site (Ceschin et al. 2009).

The abundance, diversity of flora and flowering phenology within recreational and protected areas are important natural attributes for outdoor recreational activities like hiking and camping (Nepal and Way 2007). However, increasing popularity of a recreational area can present difficult challenges for land managers, who are in charge of balancing recreational use and resource conservation (Nepal and Way 2007). Numerous studies reported loss of vegetation cover due to human trampling, clearing of shrubs and trees for trail and campsite construction (Hall and Kuss 1989), illegal harvesting of trees for firewood, and introduction of invasive species especially along the trails (Angerami de Andrade et al. 2012).

Animals can also contribute to floristic changes. For example, in the midwest and northeastern parts of the United States, deer diminish the occurrence of oaks (*Quercus*) and lilies (*Lilium*) while indirectly increase the occurrence of hemlocks (*Tsuga*), cedars (*Thuja*), and grasses (*Poaceae*) (Waller and Alverson 1997; Russell et al. 2001; Carson et al. 2005). Lefcort and Pettoello (2012) found that white-tailed deer (*Odocoileus virginianus*) trails were more plant diverse, contained more bare patches, and contained more exotic forbs compared to plots located 3 meters away in the western part of the United States. Meyers et al. (2004) reported 95% of the surviving seeds made up of exotic species in deer droppings in an eastern part of the United States. Seed survival in deer is facilitated by small rumen (Bartuszevige and Endress 2008; Wald et al. 2005; Williams and Ward 2006). Nutrients from urine and feces (especially nitrogen) can increase the ability of weeds to achieve community dominance (Harris 1967; Hobbs 1996).

Floristic and phenological studies can be conducted with different approaches including: species-level observation networks, remote sensing, and global change experiments and at different temporal and spatial scales (species-level, plot size, ecosystem- and global-scale etc., Cleland et al. 2007). Species-level phenology relies on volunteers to collect observations of various phenophases (a particular stage of development, e.g. flowering, fruiting, etc.) of plants at numerous locations (Cleland et al. 2007). Some of the longest and best known plant phenological records come from China (Chen 2003) and Japan (Aono and Kazui 2008). As noted by Cleland et al. (2007), most

of the phenological and floristic studies are concentrated in temperate climates. As time goes by, more and more species-level studies are being completed.

This study is based on the discovery of floristic and phenological analysis by Pamplin (1971) of the shores of Lake Issaqueena in Pickens County,SC, which can be potentially included in the species-level observation networks since it is managed by the Clemson University Experimental Forest personnel. Pamplin (1971) utilized traditional floristic inventory methods based on expert knowledge and field collection of plant material, much of which is stored in the Clemson University Herbarium (http://www.clemson.edu/cafls/herbarium/).

The specific objectives of the study were to conduct: 1) conduct a floristic inventory of the the shores of Lake Issaqueena, South Carolina using CVS plots; 2) take a phenological inventory using a GPS-enabled camera; and 3) qualitatively compare floristic and phenological composition in 1970-1971 and 2011-2012 in the same research area.

MATERIALS AND METHODS

Study site and land use history

Lake Issaqueena was included in a Land Use Project introduced in 1934 that covered thousands of acres encompassing Clemson University (Figure 1). The main purpose of the Land Use Project was to rehabilitate the eroded land and reintroduce native plants and wildlife (Pamplin 1971). Deterioration of the land continued from 1942-1946 when the military took over this area and utilized it as a bombing range for

Greenville Airbase. Clemson University acquired the deed for this land in 1954 and the restoration of a vibrant working forest is apparent through most of the property (Pamplin 1971). Currently, the Lake Issaqueena section of the Clemson Forest is heavily used by the public for hiking, fishing, horseback riding, and biking. There are areas for picnicking on the south west side of the lake and hunting is permitted in designated areas during specific times (Pamplin 1971). This site is within the Southern Outer Piedmont eco-region (Griffith et al. 2002). Mean temperatures for this site range from -2°C to 10°C in January. Summer temperatures range from 20°C to 32°C in July (Griffith et al. 2002). There are between 190 and 230 frost-free days annually, and mean annual precipitation ranges from 112 to 142 cm (Griffith et al. 2002). Historical climatological data were obtained from the United States Historical Climatology Network (CDIAC 2013).

Soil inventory

Soil inventory was conducted using Web Soil Survey (Soil Survey Staff, 2012).

Floristic inventory and identification in 1970-1971

The detailed plant survey of the study area was performed in 1970-1971 by Dr. John Fairy and his graduate student, William Anne Pamplin (Pamplin 1971; Pamplin and Fairey 1977). The primary goal of this study was to perform an updated inventory of the plant species present at Lake Issaqueena. The plant collection required for this research study provided the Clemson University Herbarium with ample plant specimens. Plants

were collected in the field and additional information was recorded such as: flowering time, habitat (marsh, lake side, moist woods, plantations, dry woods, road side; disturbed areas), aspect (North, South, East, and West), and occurrence (rare, throughout). According to the 1970-1971 study, the overall collection of plant species yielded a total of 1100 specimens that were properly identified and stored within the Clemson University Herbarium. This species collection consisted of 468 species (Pamplin 1971).

Floristic inventory and identification in 2011-2012

The Carolina Vegetation Survey sampling methodology (Peet et al. 1998) was used for floristic inventory and identification (Figure 2 and Figure 3). The 20 by 50 meter plots were positioned perpendicular to the shores of Lake Issaqueena with the origin point closest to the edge of the lake and the end point furthest away. The location of plots and their arrangement was determined by the flora described in each particular community sampled. Each 20 by 50 meter plot consisted of 10 modules each measuring 10m by 10m. Four of these 10 modules were designated as the intensive modules, or the modules receiving a more thorough examination compared to the other 6 modules within the plot. The four modules closest to the shores of Lake Issaqueena were designated the intensive modules in order to more thoroughly examine the research area between the lake and trails.

Phenological inventory

Blooming plants were recorded via GPS enabled camera and/or collected for future identification. Proper identification of the blooming plants was ensured by referring to the USDA Plant Database (USDA, NRCS 2013) and by relying on the expert knowledge of the curator of the Clemson University Herbarium, Dixie Damrel.

Data storage

The following tools were used to store photos and other information (Figure 4 and Figure 5): Picasa 3, and Google Website (Google, Inc. 2010).

Project website

A project Google Website was developed and used for data display, organization and storage (Figure 4 and Figure 5). Photos were uploaded in Picasa 3 and organized in web-albums. These albums were then uploaded into the Google Website and organized by date of collection. These photos are tagged with GPS coordinates and therefore could also be displayed in Google Earth. Photos of flowering plants for the phenological aspect of this study were organized by date and photos of the CVS plots within the plant communities were organized by plant community (Figure 4 and 5; Table 1). A literature review did not find any other research projects that utilized Google Websites for data storage and organization. Table 3 compares floristic and phenology tools and data storage between studies conducted in 1970-1971 and 2011-2012.

RESULTS AND DISCUSSION

Temperature and precipitation

Precipitation in 1970, 2011 and 2012 was below the long-term (50 year) average (Table 2) and this combined with higher than average air temperature (Table 1) impacted drought severity (U.S. Drought Monitor at http://drought.unl.edu). Precipitation in 1971 was above average, but the average air temperature was comparable to the long-term average (Table 2) (CDIAC 2013).

Soil inventory results

There are thirteen soil series represented in this study area with Madison (MaE2; Fine, kaolinitic, thermic Typic Kanhapludults) being the predominant series at 28.7% (Table 4). Three soil orders are represented in this study area with Ultisols being the most abundant, then Inceptisols and Entisols. Lake Issaqueena has experienced significant environmental changes over the years, especially in terms of sedimentation in the northern part (Figure 1), due to extreme storm events, erosion caused by agricultural activities and other land use change in the surrounding area (Brown 1941, Buie 1950).

Floristic inventory results

In 1970-1971, the plant inventory identified 468 plant species along the shores and the surrounding area of Lake Issaqueena. This inventory has been limited to only include the shores of Lake Issaqueena and now includes 281 plant species. The 1970-1971 plant inventory was restricted in order for the research areas to be comparable in

size; with 281 plant species collected in 1970-1971 and 208 plant species collected in 2011-2012 within the same research area. (Table 5) Table 1 lists principle plant communities of the shores of Lake Issaqueena and geographic coordinates for the CVS transect lines used in 2011-2012 study.

Phenological results

For the phenological results, the sampling times for both research periods included the whole year of study. In 1970-1971, plant inventory identified 281 plant species along the shores of Lake Issaqueena (not including the surrounding area) and 269 of these plants bloomed in eight months (March – September). In 2011-2012, plant inventory identified 208 plant species and 203 of these plant species bloomed in 11 months (February – December) (Table 6). One hundred and forty-nine plant species (found in both inventories) were observed blooming in both 1970-1971 and 2011-2012 time periods (Table 6). There appears to be extension of the blooming period by three months (November, and December, February). Three blooming peaks (May, July, and September) were identified in the 1970-1971 data (Figure 6, Figure 7). Two blooming peaks (April and August) were identified in the 2011-2012 data (Figure 6, Figure 7).

The 1970-1971 plant survey classified plants by their occurrence (rare or throughout) based on the researcher's (Dr. John E. Fairey) personal knowledge. For these two plant inventories, the term 'rare' specifically means that a particular species is considered rare in the Lake Issaqueena region only (Pamplin 1977). Following Pamplin (1971) classification, one hundred and forty-nine plant species identified in both blooming

periods contained: 1 invasive exotic plant: *Lespedeza cuneata* Dumortier and Courtois*;* 11 rare plants: *Oxypolis rigidior* Linnaeus*; Asclepias variegata* Linnaeus*; Bignonia capreolata* Linnaeus*; Campanula divaricata* Michaux*; Lobelia cardinalis* Linnaeus*; Lobelia inflata* Linnaeus*; Monotropa uniflora* Linnaeus*; Monotropa hypopithus* Linnaeus*; Amphicarpaea bracteata* Linnaeus*; Solanum carolinense* Linnaeus, and *Styrax grandifolius* Aiton. The 2011-2012 plant survey found that some of these listed rare species were found throughout the study area: *Bignonia capreolata*; *Lobelia cardinalis;* and *Amphicarpaea bracteata*. Taxonomy follows USDA Plant Database.

One hundred and seventeen plant species out of 151 plants (77%) found in both 1970-1971 and 2011-2012 plant inventories did not bloom. One hundred and four plant species out of 151 plants (69%) found in both 1970-1971 and 2011-2012 plant inventories bloomed earlier in 2011-2012. Fifty plant species out of 151 plants (33%) found in both 1970-1971 and 2011-2012 plant inventories bloomed later in 2011-2012. Nineteen plant species found in both 1970-1971 and 2011-2012 plant inventories did not have changes in blooming months: *Amianthium muscitoxicum* Walter, *Asclepias variegata*, *Bidens frondosa* Linnaeus, *Chamaecrista fasciculata* Michaux, *Clematis virginiana* Linnaeus, *Elephantopus carolinianus* Raeuschel, *Epigaea repens* Linnaeus, *Erythronium americanum* Ker Gawl., *Gentianella quinquefolia* Linnaeus, *Goodyera pubescens* Willdenow, *Leucanthemum vulgare* Lamarck, *Lysimachia quadrifolia* Linnaeus, *Monotropa uniflora*, *Oxypolis rigidior*, *Sabatia angularis* Linnaeus, *Scutellaria elliptica* Muhlenberg, *Spigelia marilandica* Linnaeus, *Thalictrum thalictroides* Linnaeus, and *Verbascum thapsus* Linnaeus. *Hypoxis hirsuta* Linnaeus was found in both 1970-

1971 and 2011-2012 plant inventories and it bloomed the longest time (7 months) in 2011-2012. Figure 8 shows that plants in 1970-1971 survey bloomed for 1-2 months compared to a more spread out type blooming pattern for 2011-2012 with more plants having longer blooming periods extending to even 7 months of blooming. Taxonomy follows USDA Plant Database.

CONCLUSIONS

The data for the floristic aspect of this study demonstrates that 208 plant species were observed and 281 plant species were observed for the 1970-1971 research period. The smaller floristic inventory for the 2011-2012 plant inventory may be due to influential environmental changes within the area over the past 40 years. However, these environmental factors and their direct influence are still unclear.

The data collected for the phenological aspect of this study has indicated that 269 plant species were observed flowering in 1970-1971 and 203 plant species observed in 2011-2012. It was determined that the phenological data collected in the 1970-1971 research period may not have been as reliable as previously thought. Therefore, the phenological data collected in the 2011-2012 research period was compared with Radford et al. first blooming data for individual plant species of the Carolinas. There is an observable shift in blooming months when compared. (Figures 10-12) The majority of plant species are observed to be blooming later and longer throughout the 2011-2012 research period when compared to Radford et al.

FUTURE RECOMMENDATIONS

This research has a great potential for replication in future studies. The restricted study area in between the lake and nature trails makes it very easy for someone to return and observe the area for possible blooming species. In addition, the GPS tagged photos taken for the phenological portion of this study can demonstrate where specific species were located around the lake and therefore may be revisited and possibly observed again. For the floristic inventory portion of this study, the GPS tagged photos of the origin and end points of every CVS plot means that the same plot can be revisited in each natural community for future data collection and study (Table 5). It is recommended that the phenological research portion of the 2011-2012 study be replicated yearly in order to collect ample data for a more in-depth statistical analysis. The floristic presence/absence portion of this study may be best replicated every five to ten years.

For future research studies, it is recommended that both the original inventory of plant species from the 1970-1971 study and the updated list from the 2011-2012 study be used. Both lists have species that have been found in the restricted area between the lake and the nature trails and all over the Lake Issaqueena area. It was observed that species found in the areas around Lake Issqueena but not on the immediate shores of the lake during the 1970-1971 study were present on the shores during the 2011-2012 study. This observation suggests that these plant species, over time, migrated and expanded their habitats to now include this area. Therefore, it is beneficial to have an overall species list of the general area and a restricted species list including only the species immediately around the lake for future study.

It would also be beneficial for future study if the Lake Issaqueena Google Website were made public so interested citizens may contribute (Miller-Rushing and Primack, 2008). Web-based services are a valuable component of phenological studies, but are still relatively new (Bradley et al., 2010) and need further development in automation and quantification of image analysis.

Successional change is inevitable and therefore it must be monitored from a managerial standpoint in order to maintain species diversity in the area. In addition, it is important to recognize that if future studies are to be completed in the same research site, this area must be influenced from successional change as little as possible. Therefore, it may be in the best interest of future research to exclude the plantation communities around the lake. Plantations follow a successional schedule set by the manager of the forest, not by nature alone. Therefore, plantation communities will experience successional change at a much quicker pace compared to the natural communities around the lake. Another successional influence that may impact future research in this study area is the sedimentation of the headwaters of Lake Issaqueena. Over time, if the headwaters are allowed to slowly fill in due to the accumulation of sediment from Six Mile Creek located above the lake, it is possible that the species abundance may be negatively affected.

It is also important to note that the impact of humans is great around Lake Issaqueena and therefore should be monitored. Not only is litter an obvious problem but certain areas around the dam are now bare dirt due to trampling and camping. In addition, it has been observed that certain species have been taken from the area evident

by a cut stem left behind. *Verbascum thapsus* Linnaeus and *Yucca filamentosa* Linnaeus both have been taken shortly after they bloomed. Signs of damage caused by hogs and beavers have also been observed around Lake Issaqueena. These two species can have a great impact on floristic diversity and management should therefore monitor their behavior and environmental influence. It is important for the future study of this research site that the area be monitored by management in order to lessen the negative influence of succession, invasive animals, and anthropogenic impact on floristic diversity.

APPENDICES

Appendix A

Figures

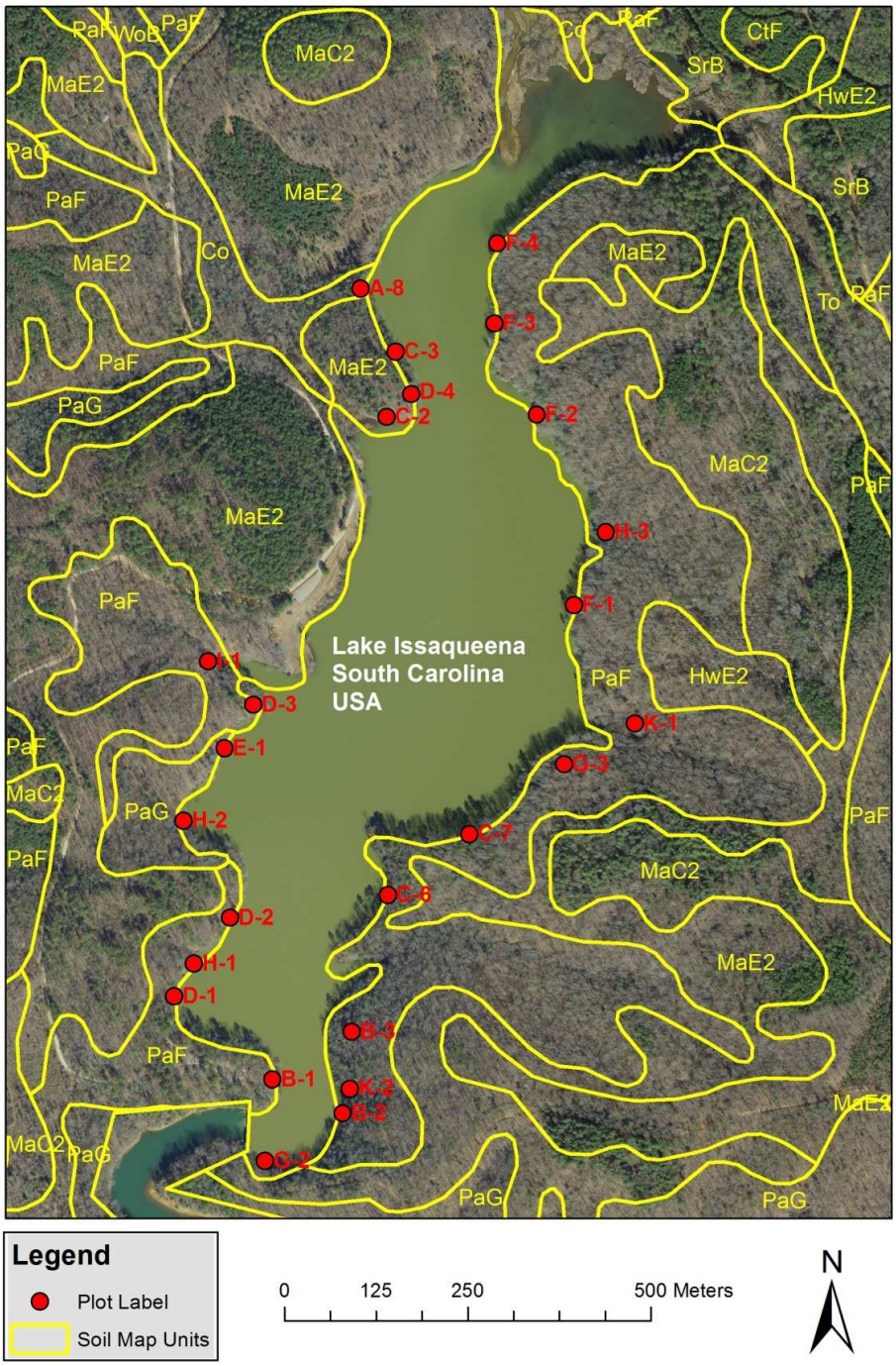

Figure 1. Aerial photograph and principle plant communities of the shores of Lake Issaqueena; includes soil map units from Web Soil Survey.

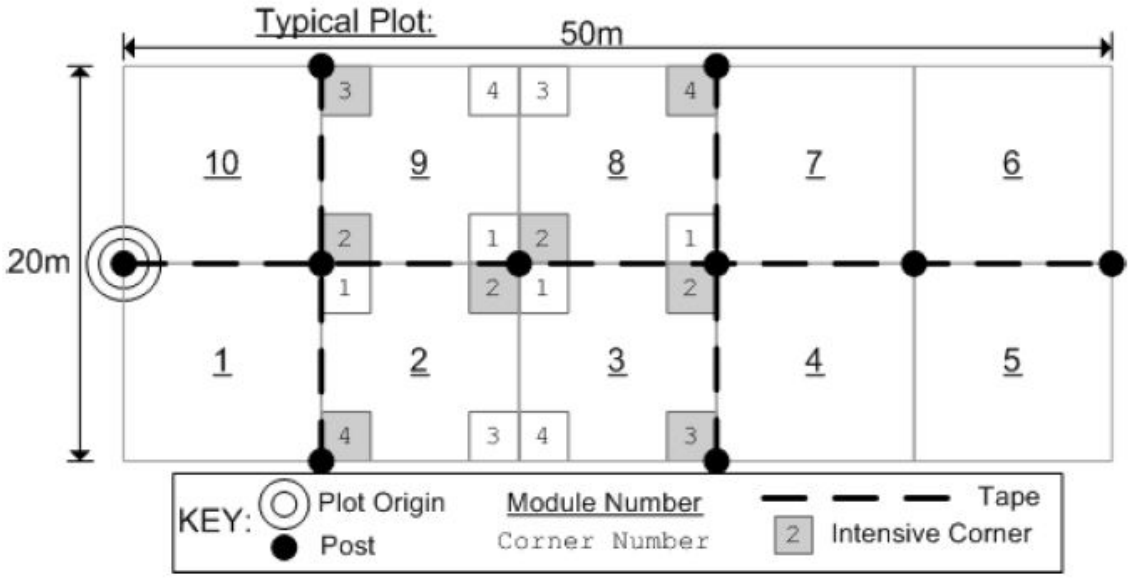

Figure 2. Example of Carolina Vegetation Survey (CVS) plot.

Figure 3. Example of measuring out the CVS plot.

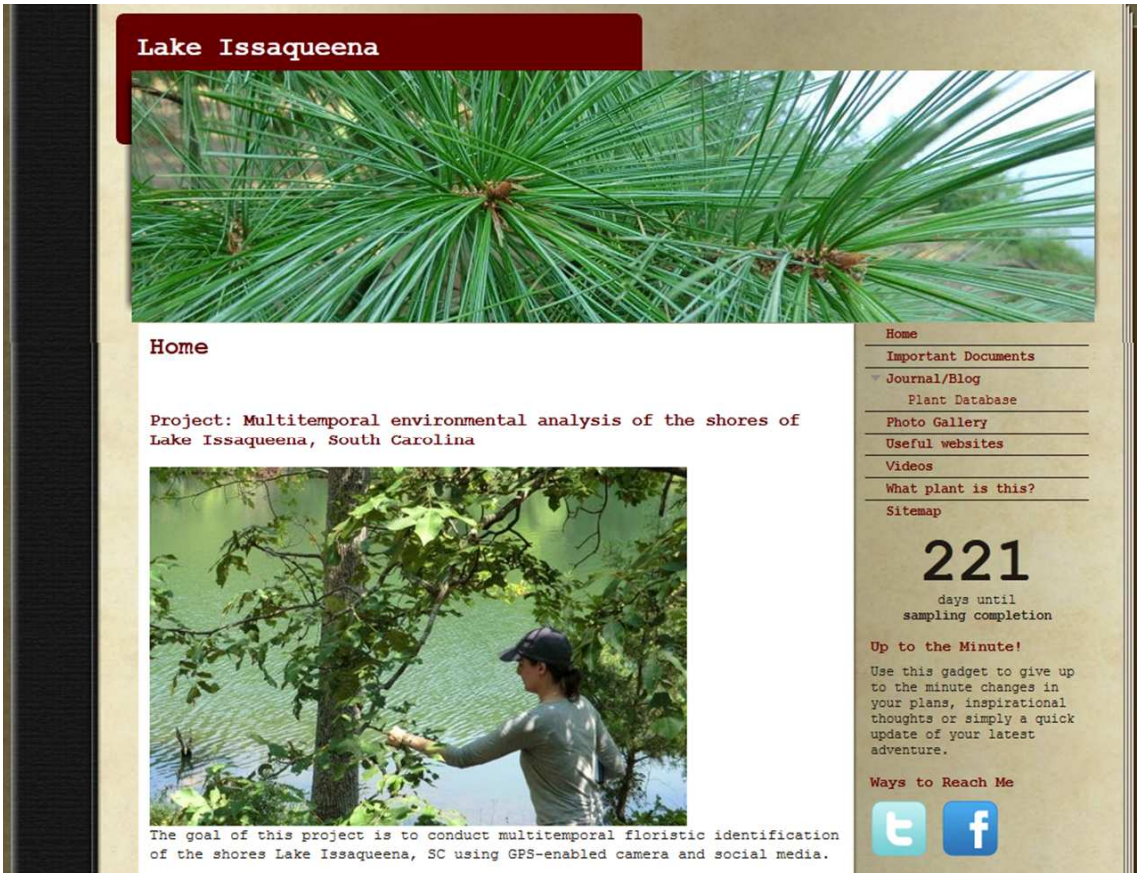

Figure 4. Screen capture of Google website used for project organization and data storage.

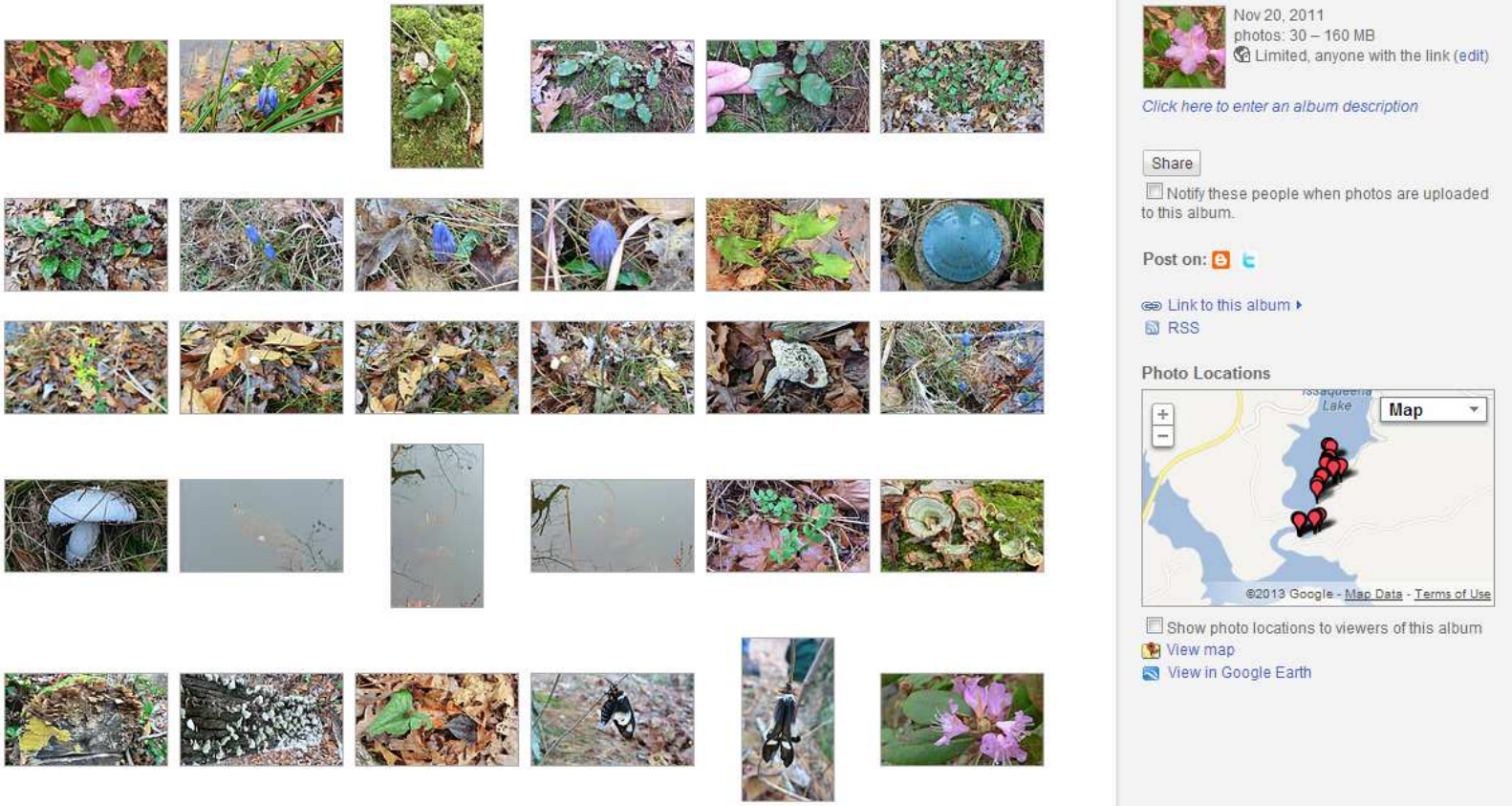

Figure 5. Example of data storage in Google website.

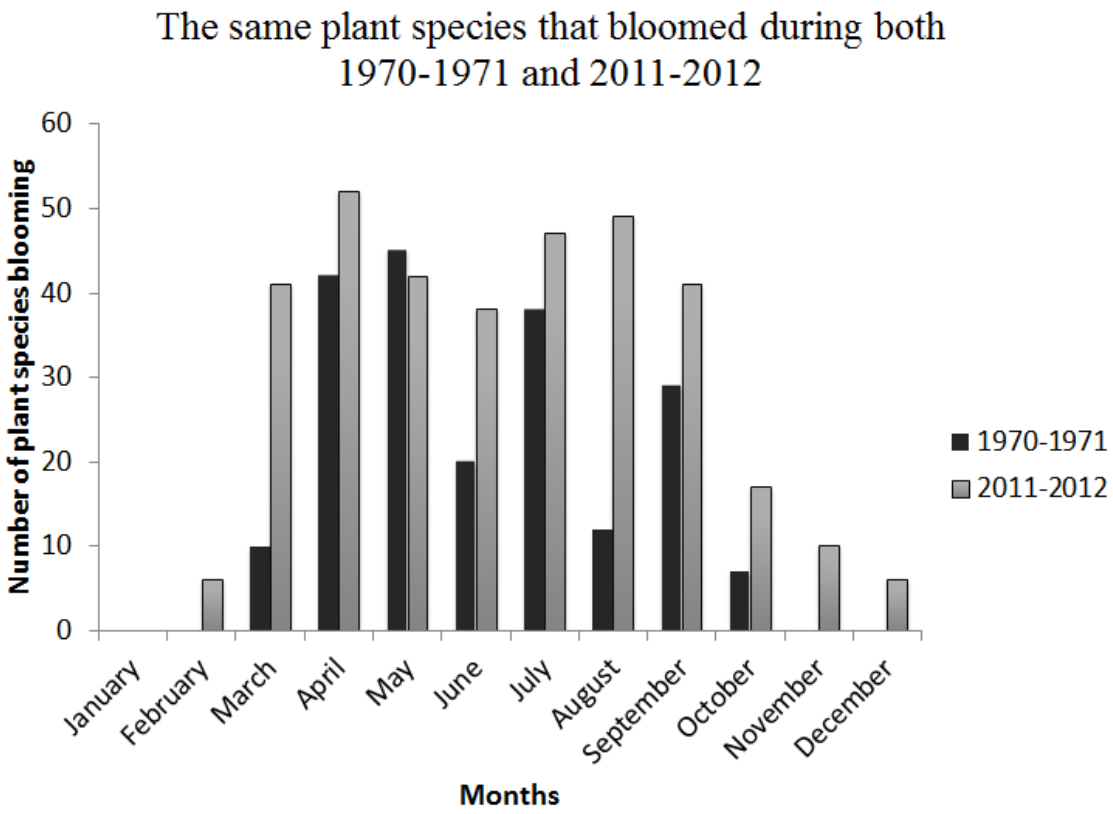

Figure 6. Counts of same plant species that bloomed during both years 1970-1971 and 2011-2012

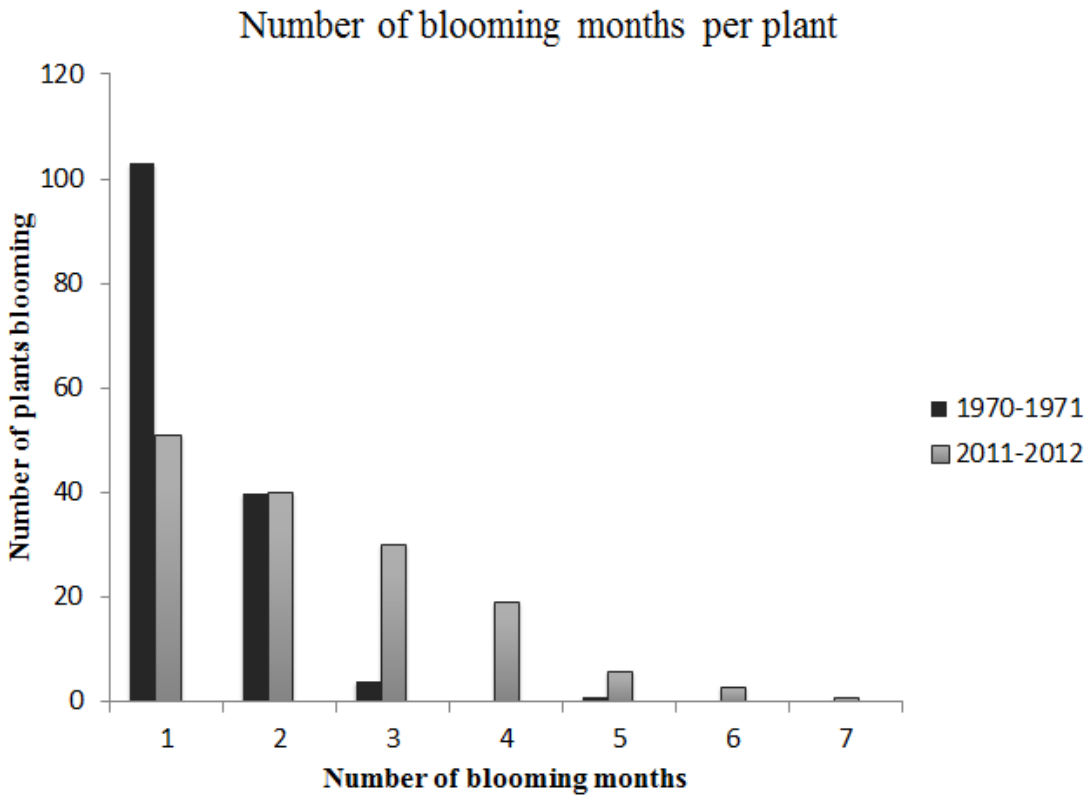

Figure 7. Comparison of number of blooming months per plant in 1970-1971 and 2011-2012

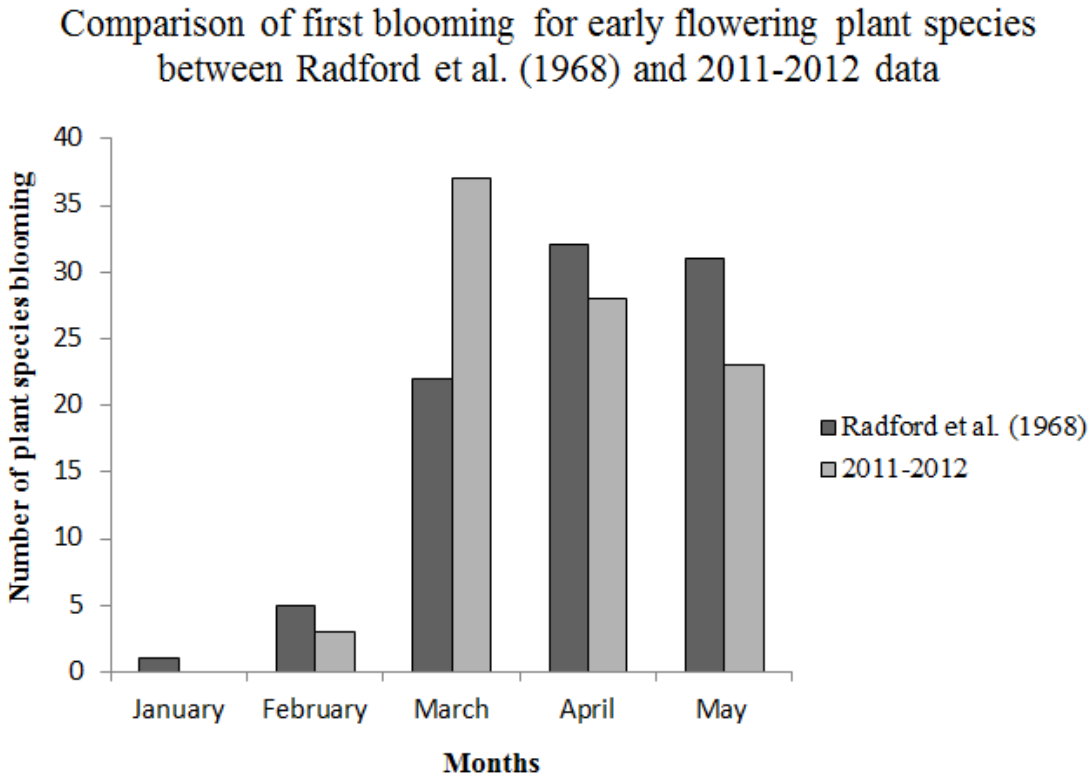

Figure 8. Comparison of first blooming for early flowering plant species between Radford et al. (1968) and 2011-2012 data

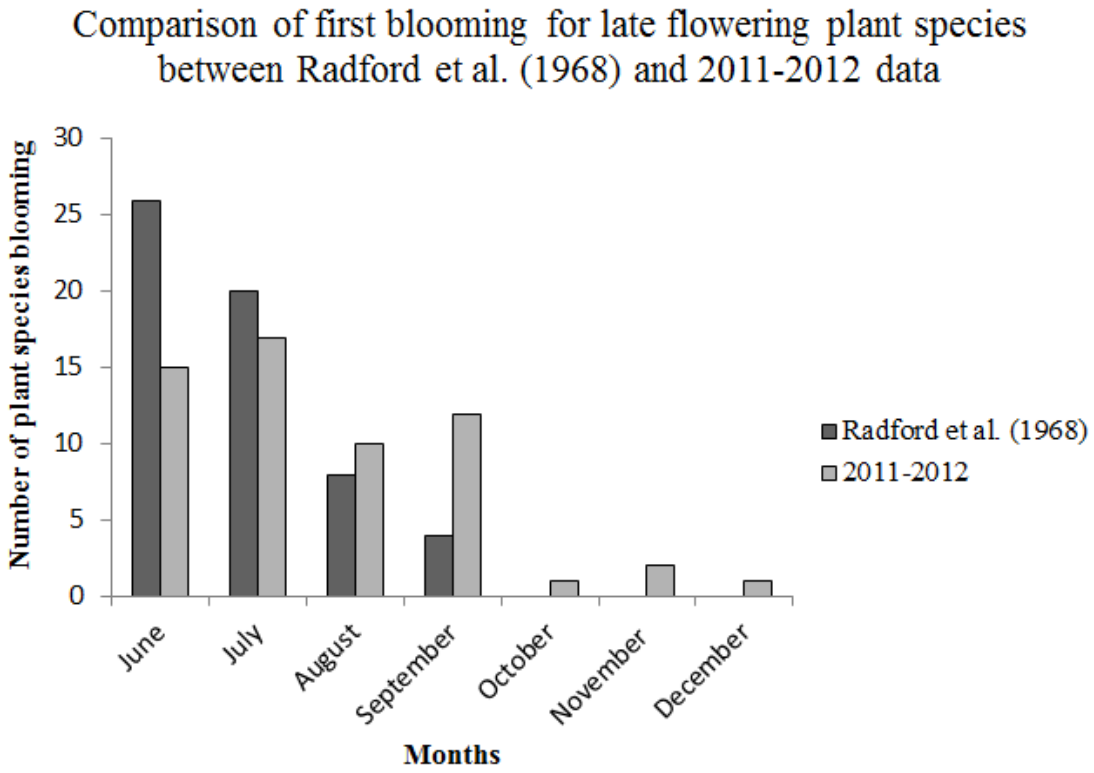

Figure 9. Comparison of first blooming for late flowering plant species between Radford et al. (1968) and 2011-2012 data

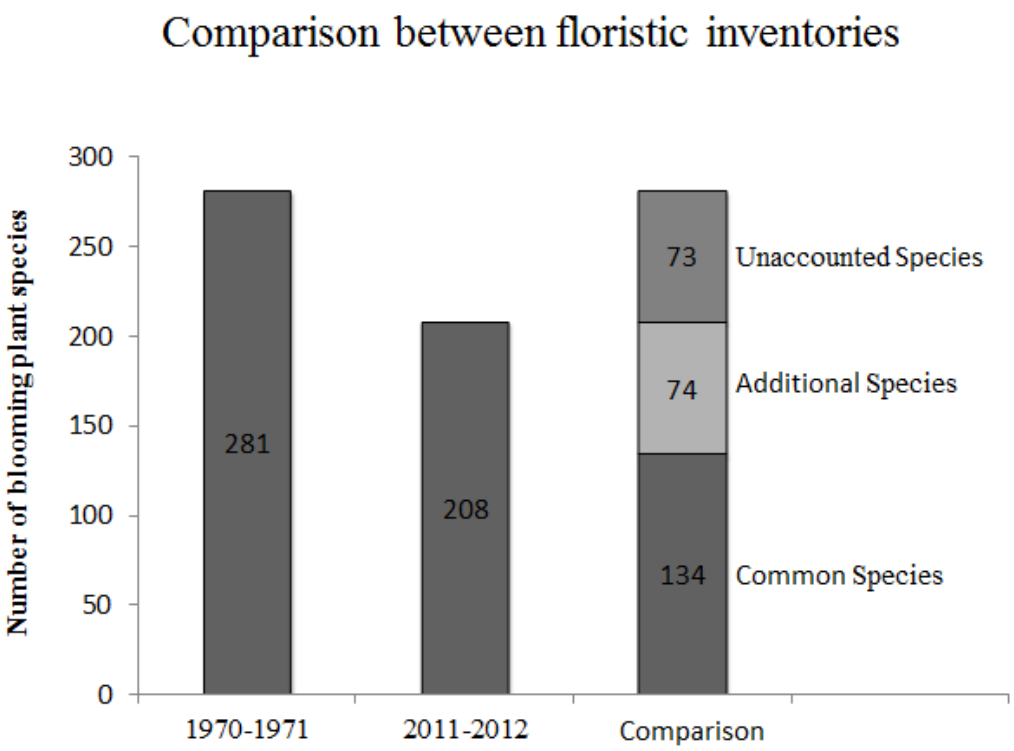

Figure 10. Comparison floristic inventories for 1970-1971 and 2011-2012 data

Appendix B

Tables

Table 1. Principle plant communities of the shores of Lake Issaqueena 2011-2012 with GPS coordinates (see Figure 1 for locations on the map).

No.	Principal Communities	Plot Label	Origin GPS Point	End GPS Point
1	Mixed Pine Plantation	A-8	N 34º 44' 43" 04 W 82º 51' 46" 26	N 34º 44' 42" 67 W 82º 51' 47" 97
2	Pine-Oak Community	B-1	N 34º 44' 07" 99 W 82º 51' 50" 22	N 34º 44' 07" 74 W 82º 51' 52" 02
3	Pine-Oak Community	B-2	N 34º 44' 06" 54 W 82º 51' 46" 42	N 34º 44' 06" 40 W 82º 51' 45" 31
4	Pine-Oak Community	B-3	N 34º 44' 10" 15 W 82º 51' 46" 03	N 34º 44' 09" 78 W 82º 51' 45" 49
5	Pine-Hardwood Community	C-2	N 34º 44' 37" 38 W 82º 51' 44" 76	N 34º 44' 38" 76 W 82º 51' 44" 79
6	Pine-Hardwood Community	C-3	N 34º 44' 40" 27 W 82º 51' 44" 33	N 34º 44' 39" 79 W 82º 51' 45" 70
7	Pine-Hardwood Community	C-6	N 34º 44' 16" 23 W 82º 51' 44" 22	N 34º 44' 15" 21 W 82º 51' 43" 04
8	Pine-Hardwood Community	C-7	N 34º 44' 19" 00 W 82º 51' 39" 91	N 34º 44' 17" 26 W 82º 51' 39" 67
9	Oak-Hickory Community	D-1	N 34º 44' 11" 59 W 82º 51' 55" 59	N 34º 44' 12" 78 W 82º 51' 56" 84
10	Oak-Hickory Community	D-2	N 34º 44' 15" 10 W 82º 51' 52" 66	N 34º 44' 16" 37 W 82º 51' 53" 37
11	Oak-Hickory Community	D-3	N 34º 44' 24" 55 W 82º 51' 51" 63	N 34º 44' 24" 82 W 82º 51' 52" 23
12	Oak-Hickory Community	D-4	N 34º 44' 38" 42 W 82º 51' 43" 45	N 34º 44' 38" 63 W 82º 51' 44" 64
13	Hickory Community	E-1	N 34º 44' 22" 60 W 82º 51' 53" 12	N 34º 44' 23" 07 W 82º 51' 54" 35
14	Mixed Hardwood Community	F-1	N 34º 44' 29" 22 W 82º 51' 34" 52	N 34º 44' 29" 21 W 82º 51' 33" 49
15	Mixed Hardwood Community	F-2	N 34º 44' 37" 59 W 82º 51' 36" 69	N 34º 44' 35" 86 W 82º 51' 32" 79
16	Mixed Hardwood Community	F-3	N 34º 44' 41" 61 W 82º 51' 40" 49	N 34º 44' 36" 97 W 82º 51' 34" 83
17	Mixed Hardwood Community	F-4	N 34º 44' 45" 15 W 82º 51' 38" 98	N 34º 44' 44" 13 W 82º 51' 37" 00
18	Oak-Beech Community	G-2	N 34º 44' 04" 38 W 82º 51' 50" 55	N 34º 44' 03" 21 W 82º 51' 51" 27
19	Oak-Beech Community	G-3	N 34º 44' 22" 15 W 82º 51' 34" 89	N 34º 44' 22" 98 W 82º 51' 34" 78
20	Tulip Poplar-Hickory Community	H-1	N 34º 44' 13" 04 W 82º 51' 53" 04	N 34º 44' 14" 19 W 82º 51' 56" 20
21	Tulip Poplar-Hickory Community	H-2	N 34º 44' 19" 36 W 82º 51' 55" 25	N 34º 44' 18" 53 W 82º 51' 56" 66
22	Tulip Poplar-Hickory Community	H-3	N 34º 44' 32" 46 W 82º 51' 32" 18	N 34º 44' 32" 21 W 82º 51' 30" 02
23	Beech Community	I-1	N 34º 44' 26" 43 W 82º 51' 54" 09	N 34º 44' 25" 44 W 82º 51' 54" 91
24	Mesic Mixed Hardwood Community	K-1	N 34º 44' 24" 01 W 82º 51' 31" 14	N 34º 44' 22" 88 W 82º 51' 29" 11
25	Mesic Mixed Hardwood Community	K-2	N 34º 44' 07" 62 W 82º 51' 46" 06	N 34º 44' 07" 81 W 82º 51' 45" 10

Table 2. Monthly total precipitation (cm) and monthly average temperature (°C) for 1970, 1971, 2011, 2012 and 50-year mean (Source: U.S. Historical Climatology Network - Monthly Data, Site 381770, Clemson University, South Carolina).

	1970		1971		2011		2012		50-year mean	
Month	Mean temp., °C	Precip., cm	Mean temp., °C	Precip., cm	Mean temp., °C	Precip., cm	Mean temp., °C	Precip., cm	Mean temp., °C	Precip., cm
January	2	6	6	12	4	5	9	11	5	13
February	7	9	7	17	9	11	9	5	7	12
March	11	10	9	16	12	16	17	6	11	14
April	17	9	16	9	18	9	18	6	16	10
May	21	7	19	10	21	5	22	8	20	10
June	25	4	25	10	26	12	24	16	24	10
July	27	6	25	17	28	5	27	12	26	11
August	26	18	25	12	27	2	25	21	25	12
September	25	4	24	10	22	10	22	6	22	10
October	18	15	19	16	15	4	16	7	16	10
November	10	4	10	16	12	11	10	2	11	10
December	9	8	11	15	9	10	9	13	7	12
Total precip.:		100		159		101		112		134
Mean temp.	16		16		17		17		16	

Table 3. Comparison of phenology tools and data storage between studies conducted in 1970-1971 and 2011-2012.

	1970-1971	2011-2012
Tools	Plant Press	Digital Camera (GPS)
	Camera	Plant Press
	Plant Field Guides	USDA Plant Database
		Plant Field Guides
Data storage	Herbarium	Google Website
		Picasa 3
		Herbarium

Table 4. Soils of the shores of Lake Issaqueena.

Soil map unit name (map unit symbol)	Family or higher taxonomic classification
Chewacla soils, frequently flooded (Co)	Fine-loamy, mixed, active, thermic Fluvaquentic Dystrudepts
Hiwassee sandy loam, 10 to 25% slopes eroded (HwE2)	Very-fine, kaolinitic, thermic Rhodic Kanhapludults
Madison sandy loam, 10 to 25% slopes, eroded (MaE2)	Fine, kaolinitic, thermic Typic Kanhapludults
Pacolet fine sandy loam, 25 to 40% slopes (PaF)	Fine, kaolinitic, thermic Typic Kanhapludults
Pacolet fine sandy loam, 40 to 80% slopes (PaG)	Fine, kaolinitic, thermic Typic Kanhapludults
Rabun cobbly loam, 25 to 40%slopes (RaF)	Fine, kaolinitic, mesic Typic Kanhapludults
Starr loam, 0 to 6% slopes (SrB)	Fine-loamy, mixed, semiactive, thermic Fluventic Dystrudepts
Toccoa soils (To)	Coarse-loamy, mixed, active, nonacid, thermic Typic Udifluvents

Table 5. Presence/Absence floristic inventory list for 1970-1971 and 2011-2012. Presence indicated by x.

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
1	Aceraceae	1	*Acer rubrum* L. (Red Maple)	3		T	Common, throughout the area.	x	x
2	Agavaceae	2	**Yucca filamentosa* L. (Adam's Needle)	5		T	Dry woods on both sides of the lake.	x	x
3	Anacardiaceae	3	**Toxicodendron radicans* (L.) Kuntze ssp. *radicans* (Eastern Poison Ivy)	5		T	Common, throughout the area.	x	
		4	*Rhus copallinum L.* (Winged Sumac)	5	E		Infrequent, on the east side and at Wildcat Creek.	x	x
4	Apiaceae	5	[1]*Oxypolis rigidior* (L.) Raf. (Stiff Cowbane)	3	E	R	On the southeast side of the lake.	x	
		6	*Sanicula canadensis* L. (Canadian Blacksnakeroot)	3		T	Common on south-facing slopes above the lake and on both sides of the lake.	x	x
		7	*Thaspium barbinode* (Michx.) Nutt. (Hairyjoint Meadow Parsnip)	3	E		Frequent, along the trails of the northeast side and in Indian Creek.	x	
		8	**Thaspium trifoliatum* (L.) A. Gray (Purple Meadowparsnip)	3	N		Rich woods on the northwest side of the lake.	x	
		9	*Zizia trifoliata* (Michx.) Fernald (Meadow Alexanders)	3	N		Rich woods on the northeast side and at Wildcat Creek.	x	
5	Aquifoliaceae	10	*Ilex opaca* Aiton (American Holly)	3		T	Frequent, all around the lake.	x	x
6	Araceae	11	*Arisaema triphyllum* (L.) Schott (Jack in the Pulpit)	3	W		Marsh areas on the west side.	x	x
		12	**Peltandra virginica* (L.) Schott (Green Arrow Arum)	2	W		Along the edge of the water on the west side.	x	
7	Araliaceae	13	*Aralia spinosa* L. (Devil's Walkingstick)	3	E,N		Infrequent, on the northeast side and at the east dam area.	x	
		14	*Panax quinquefolius* L. (American Ginseng)	3	E	R	In moist coves on the mideast side.	x	
8	Aristolochiaceae	15	*Hexastylis arifolia* (Michx.) Small (Littlebrownjug)	3		T	Common on both sides of the lake in rich woods.	x	x
9	Asclepiadaceae	16	*Asclepias tuberosa* L. (Butterfly Milkweed)	5	W		Margins of dry woods at the west dam area and along roadsides.	x	
		17	[1]*Matelea carolinensis* (Jacq.) Woodson (Maroon Carolina Milkvine)	3	W	R	In mixed woods on midwest side of the lake.	x	x
10	Aspleniaceae	18	*Asplenium platyneuron* (L.) Britton, Sterns & Poggenb. (Ebony Spleenwort)	5		T	Common throughout the area.	x	x

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
11	Asteraceae	19	*Ageratina altissima* (L.) King & H. Rob. Var. *altissima* (White Snakeroot)	3		T	Common, on both sides.	x	x
		20	*Ambrosia artemisiifolia* L. (Common Ragweed)	7		T	Frequent, in disturbed areas.	x	x
		21	*Antennaria plantaginifolia* (L.) Richardson (Pussy-toes)	6		T	Frequent, along roadsides and midwest side.	x	
		22	*Arnoglossum atriplicifolium* (L.) H. Rob. (Pale Indian Plantain)	3	E		Infrequent, on east side and marsh of Six Mile Creek.	x	x
		23	**Bidens frondosa* L. (Devil's Beggartick)	1	N		Frequent in the marsh of Six Mile Creek and on both sides of the dam.	x	
		24	*Cirsium altissimum* (L.) Hill (Tall Thistle)	6	N		Infrequent, along roadsides and south-facing slopes.	x	
		25	*Chrysogonum virginianum* L. var. *australe* (Alexander ex Small) H.E. Ahles (Green and Gold)	5		T	Common throughout the area.	x	x
		26	*Chrysopsis mariana* (L.) Elliott (Maryland Goldenaster)	1		T	Frequent in marsh area, along the east side and at Indian Creek.	x	x
		27	*Coreopsis major* Walter (Greater Tickseed)	5		T	Common throughout the area.	x	x
		28	*Doellingeria infirma* (Michx.) Greene (Cornel-Leaf Whitetop)	3	W	R	Rich woods on the midwest side.	x	x
		29	*Elephantopus carolinianus Raeusch*. (Carolina Elephantsfoot)	6	W,E		Infrequent, along roadsides and at the east dam area.	x	
		30	*Elephantopus tomentosus* L. (Devil's Grandmother)	3		T	Frequent, in rich woods on both sides.	x	x
		31	*Erigeron pulchellus* Michx. (Robin's Plantain)	5		T	Common throughout the area.	x	
		32	*Eupatorium capillifolium* (Lam.) Small (Dog-fennel)	1	N		Frequent, in marsh and northwest side.	x	x
		33	*Eupatorium serotinum* Michx. (Lateflowering Thoroughwort)	3	W	R	In cove on midwest side.	x	

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		34	*Eutrochium fistulosum* (Barratt) E.E. Lamont (Trumpetweed)	2	W		Frequent, along the water on the west side, and in the marsh of Six Mile Creek.	x	
		35	*Eutrochium purpureum* (L.) E.E. Lamont (Sweetscented Joe Pye Weed)	5		T	Frequent, on both sides of the lake.	x	
		36	[1]*Helenium amarum* (Raf.) H. Rock (Sneezeweed)	5	E	R	In cleared, dry area on the east side of the dam.	x	
		37	*Helianthus atrorubens* L. (Purpledisk Sunflower)	6		T	Common on roadsides and on the trails of Indian Creek and the west side of the lake.	x	
		38	*Helianthus divaricatus* L. (Woodland Sunflower)	1	N		Frequent in marsh of Six Mile Creek, Indian Creek, and the west side of the lake.	x	
		39	[1]*Helianthus strumosus* L. (Paleleaf Woodland Sunflower)	1	N	R	On the southwest side of the lake.	x	x
		40	*Hieracium venosum* L. (Rattlesnakeweed)	5		T	Common, throughout the area.	x	x
		41	*Leucanthemum vulgare* Lam. (Oxeye Daisy)	5		T	Common throughout the area.	x	
		42	*Liatris microcephala* (Small) K. Schum. (Smallhead Blazing Star)				Frequent, on the east side of the lake, Indian Creek and Willow Springs.	x	
		43	*Liatris virgata* Nutt. (Wand Blazing Star)	5		T	Frequent, on the east side of the lake, Indian Creek and Willow Springs.	x	x
		44	*Parthenium integrifolium* L. (Wild Quinine)	5	W		Infrequent on the northwest side of the lake.	x	
		45	*Pityopsis graminifolia* (Michx.) Nutt. var. *graminifolia* (Narrowleaf Silkgrass)	5	N		Frequent on the east side and along trails of Indian Creek.	x	
		46	*Prenanthes altissima* L. (Tall Rattlesnakeroot)	3	E		Infrequent, in rich woods on the east side and at Indian Creek.	x	x
		47	**Pseudognaphalium obtusifolium* (L.) Hillard & B.L. Burtt ssp. *obtusifolium* (Rabbit-Tobacco)	3		T	Common on both sides of the dam, and marsh of Six Mile Creek.	x	x
		48	*Rudbeckia fulgida* Aiton (Orange Coneflower)	3	N	R	In moist woods at the north end.	x	
		49	*Rudbeckia hirta* L. (Black-eyed Susan)	5		T	Common throughout the area.	x	
		50	*Sericocarpus asteroides* (L.) Britton, Sterns & Poggenb. (Toothed Whitetop Aster)	5		T	Common throughout the area.	x	x

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		51	*Silphium asteriscus* L. var. *laevicaule* DC. (Starry Rosinweed)	5		T	Common throughout the area.	x	
		52	[1]*Silphium compositum* Michx. (Kidneyleaf Rosinweed)	5	E		Infrequent at the east dam area and on the northwest side.	x	
		53	*Smallanthus uvedalius* (L.) Mack. Ex Small (Hairy Leafcup)	3	E		Frequent on east side and disturbed areas.	x	x
		54	**Solidago caesia* L. (Wreath Goldenrod)	5	W		Frequent on the west side.	x	x
		55	[1]*Solidago erecta* Pursh (Showy Goldenrod)	5	E		Infrequent at the east dam area.	x	x
		56	[1]*Solidago odora* Aiton (Anisescented Goldenrod)	5	E		Infrequent on the east side of the lake.	x	x
		57	[*1]*Symphyotrichum pilosum* (Willd.) G.L. Nesom var. *pilosum* (Hairy White Oldfield Aster)	3	E	R	Rich woods on the east side of the dam.	x	
		58	*Symphyotrichum undulatum* (L.) G.L. Nesom (Wavyleaf Aster)	5		T	Common on both sides of the lake.	x	
		59	*Verbesina occidentalis* (L.) Walter (Yellow Crownbeard)	5	W,E		Rare, scattered on both sides of the lake.	x	
		60	[1]*Verbesina virginica* L. (White Crownbeard)	3	W		Rare, on the northwest side of the lake near the marsh of Six Mile Creek.	x	x
		61	*Vernonia glauca* (L.) Willd. (Broadleaf Ironweed)	6	W		Infrequent, along roadsides and midwest side.	x	x
12	Berberidaceae	62	*Podophyllum peltatum* L. (Mayapple)	3	E		Moist north-facing cove on the northeast side of the lake.	x	x
13	Betulaceae	63	*Alnus serrulata* (Aiton) Willd. (Hazel Alder)	2		T	Common all around the lake on the edge of the water.	x	
		64	*Carpinus caroliniana* Walter (American Hornbeam)	3		T	Common all around the lake.	x	x
		65	*Corylus americana* Walter (American Hazelnut)	2		T	Common all around the lake.	x	
		66	**Corylus cornuta* Marshall (Beaked Hazelnut)	5		T	Dry woods on both side of the lake.	x	

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
14	Bignoniaceae	67	*Campsis radicans* (L.) Seem. Ex Bureau (Trumpet Creeper)	4	N		Infrequent, at west dam area and pine plantations	x	
15	Boraginaceae	68	**Cynoglossum virginianum* L. (Wild Comfrey)	3	E		Infrequent, in coves on the northeast side.	x	x
16	Calycanthaceae	69	*Calycanthus floridus* L. (Eastern Sweetshrub)	3		T	Common in rich woods throughout.	x	x
17	Campanulaceae	70	*Specularia perfoliata* (L.) Nieuwl. (Clasping Venus' Looking-Glass)	5	N	R	On northern south-facing slope.	x	
		71	[1]*Campanula divaricata* Michx. (Small Bonny Bellflower)	5	E	R	On southeast side.	x	
		72	*Lobelia puberula* Michx. (Downy Lobelia)	5		T	Common, throughout the area.	x	x
		73	*Lobelia spicata* Lam. (Palespike Lobelia)	5	W		Infrequent, on the northwest side of the lake, and Wildcat Creek.	x	
18	Caprifoliaceae	74	*Lonicera japonica* Thunb. (Japanese Honeysuckle)	5		T	Common, throughout the area.	x	
		75	*Lonicera sempervirens* L. (Coral Honeysuckle)	5		T	Infrequent, on both sides of the lake.	x	
		76	*Viburnum rufidulum* Raf. (Rusty Blackhaw)	5		T	Infrequent, on both sides	x	
19	Caryophyllaceae	77	*Silene stellata* (L.) W.T. Aiton (Widowsfrill)	3	N		Rich woods of the northeast side of the lake.	x	x
		78	*Silene virginica* L. (Fire Pink)	3		T	Rich woods on both sides of the lake.	x	
		79	**Stellaria pubera* Michx. (Star Chickweed)	3		T	Rich woods on both sides of the lake.	x	
20	Celastraceae	80	*Euonymus americanus* L. (Bursting-Heart)	3		T	Common, throughout the area.	x	x
21	Clusiaceae	81	[1]*Hypericum hypericoides* (L.) Crantz (St. Andrew's Cross)	5	W		West dam area.	x	x
22	Commelinaceae	82	*Tradescantia subaspera* Ker Gawl. (Zigzag Spiderwort)	5	N		Dry woods on the north end.	x	x
23	Cornaceae	83	*Cornus amomum* Mill. (Silky Dogwood)	2		T	Frequent, near water on both sides of the lake, and in the marsh of Six Mile Creek.	x	x
		84	*Cornus florida* L. (Flowering Dogwood)	3		T	Common, throughout the area.	x	x
		85	*Nyssa sylvatica* Marshall (Blackgum)	3	N		Common, throughout the area.	x	
24	Cupressaceae	86	*Juniperus virginiana* L.(Eastern Redcedar)	5		T	Dry woods throughout the area.	x	x

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		87	*[1]*Taxodium distichum* (L.) Rich. (Bald Cypress)	2	N	R	(Planted) Rare, on the edge of water on the northwest side.	x	
25	Cuscutaceae	88	*Cuscuta compacta* Juss. Ex Choisy (Compact Dodder)	2		T	Common, entwined in water edge plants.	x	
26	Cyperaceae	89	**Carex gynandra* Schwein. (Nodding Sedge)	1		T	Marsh areas all around the lake.	x	
		90	*Carex lurida* Wahlenb. (Shallow Sedge)	1		T	Marsh areas all around the lake.	x	
		91	*Rhynchospora glomerata* (L.) Vahl. (Clustered Beaksedge)	1		T	Marsh areas all around the lake.	x	
		92	*Scleria oligantha* Michx. (Littlehead Nutrush)	5	E,W		Dry areas on both sides of the lake.	x	x
27	Dennstaedtiaceae	93	*[1]Dennstaedtia punctilobula* (Michx.) T. Moore (Eastern Hayscented Fern)	5		R	In dry open area on midwest side of the lake.	x	
		94	*Pteridium aquilinum* (L.) Kuhn. (Western Bracken Fern)	5	W		Scattered in rich woods on the west side.	x	x
28	Diapensiaceae	95	*Galax urceolata* (Poir.) Brummitt (Beetleweed)	3	E,S		Ground cover dominant of the north-facing Beech-Oak slope at the east dam area.	x	x
		96	*Shortia galacifolia* Torr. & A. Gray (Oconee Bells)	3	E		Transplanted-planted along a stream on the southeast side.	x	
29	Dioscoreaceae	97	*Dioscorea villosa* L. (Wild Yam)	3		T	Rich woods all around the lake.	x	x
30	Dryopteridaceae	98	*Polystichum acrostichoides* (Michx.) Schott (Christmas Fern)	3		T	Common on all shades slopes.	x	x
31	Ericaceae	99	*Epigaea repens* L. (Trailing Arbutus)	5	E		Dry woods on the southeast side.	x	x
		100	*Kalmia latifolia* L. (Mountain Laurel)	3	E,W		Common, on the mideast to southeast side of the lake and the west dam area.	x	x
		101	*Leucothoe fontanesiana* (Steud.) Sleumer (Highland Doghobble)	3	W		Infrequent, in rich woods of the southwest side.	x	x
		102	*Lyonia ligustrina* (L.) DC. (Maleberry)	3	E		Infrequent, on the southeast side of the dam.	x	
		103	*Oxydendrum arboreum* (L.) DC. (Sourwood)	3		T	Common, throughout the area.	x	x
		104	[1]*Rhododendron arborescens* (Pursh) Torr. (Smooth Azalea)	3	E	R	At the west dam area.	x	

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		105	*Rhododendron calendulaceum* (Michx.) Torr. (Flame Azalea)	3	E		Infrequent on the southeast side.	x	x
		106	[1]*Rhododendron maximum* L. (Great Laurel)	3	W	R	In a moist cove on the midwest side of the lake.	x	
		107	*Rhododendron minus* Michx. (Piedmont Rhododendron)	3	E		Frequent, in thickets on the southeast side of the lake.	x	x
		108	*Rhododendron periclymenoides* (Michx.) Shinners (Pink Azalea)				Infrequent, at the west dam area.	x	
		109	*Vaccinium arboreum* Marshall (Farkleberry)	5	E		Dry woods on the southeast side.	x	x
		110	*Vaccinium pallidum* Aiton (Blue Ridge Blueberry)	5		T	Dry woods on the southeast side.	x	x
		111	*Vaccinium stamineum* L. (Deerberry)	4	N		Frequent, in pine dominant areas of Indian Creek and on the northwest side of the lake.	x	x
32	Euphorbiaceae	112	*Chamaesyce maculata* (L.) Small (Spotted Sandmat)	5	S		Infrequent, on both sides of the dam.	x	
		113	*Euphorbia corollata* L. (Flowering Spurge)	5		T	Common, throughout the area.	x	x
33	Fabaceae	114	*Apios americana* Medik. (Groundnut)	2		T	Scattered in thickets near the water.	x	
		115	*Centrosema virginianum* (L.) Benth. (Spurred Butterfly Pea)	4		T	Infrequent in open pine woods.	x	x
		116	**Cercis canadensis* L. (Eastern Redbud)	3		T	Common throughout the area.	x	x
		117	*Clitoria mariana* L. (Atlantic Pigeonwings)	7		T	Infrequent in clearing on both sides of the lake.	x	x
		118	*[1]*Crotalaria sagittalis* L. (Arrowhead Rattlebox)	7	N		Cleared area along the water on the northwest side.	x	
		119	*[1]*Desmodium canescens* (L.) DC (Hoary Ticktrefoil)	5	W	R	At the dam on the west side.	x	
		120	*Desmodium rotundifolium* DC. (Prostrate Ticktrefoil)	3	W		Common in rich woods on the west side of the lake.	x	x
		121	*[1]*Lathyrus venosus* Muhl. Ex Willd. (Veiny Pea)	7	W		Clearing on the west side of the dam.	x	
		122	*Lespedeza repens* (L.) W.P.C. Barton (Creeping Lespedeza)	5	N		Infrequent, in woods along marsh of Six Mile Creek and at the west side of the dam.	x	x

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		123	*Mimosa microphylla* Dryand. (Littleleaf Sensitive-Briar)	6		T	Frequent, along the road and rocky edges of the lake.	x	x
		124	**Pueraria montana* (Lour.) Mer.var. *lobata* (Willd.) Maesen & S. Almeida (Kudzu)	5	N		Scattered in woods on the northern end of the lake and covering a clearing on the midwest side of the lake.	x	
		125	*Stylosanthes biflora* (L.) Britton, Sterns & Poggenb. (Sidebeak Pencilflower)	7	W		Infrequent, in cleared area along the water on the northwest side of the lake and at Wildcat Creek.	x	x
		126	*Tephrosia spicata* (Walter) Torr. & A. Gray (Spiked Hoarypea)	7	E		Clearing along the water on the northwest side.	x	x
		127	*Tephrosia virginiana* (L.) Pers. (Virginia Tephrosia)	7	E		Clearing on the east side of the dam.	x	x
		128	**[1]Trifolium dubium* Sibth. (Suckling Cover)	7	W		Cleared area along the water on the northwest side.	x	
		129	**Wisteria sinensis* (Sims) DC. (Chinese Wisteria)	5	E		Infrequent, on the east side of the dam.	x	
34	Fagaceae	130	*Castanea dentata* (Marshall) Borkh. (American Chestnut)	3	N		Scattered on both sides of the lake, Wildcat Creek and Holly Springs.	x	
		131	*Fagus grandifolia* Ehrh. (American Beech)	3		T	Common in rich woods on both sides of the lake.	x	x
		132	*Quercus alba* L. (White Oak)	3		T	Common all around the lake.	x	x
		133	**Quercus coccinea* Munchh. (Scarlet Oak)	5	S		Common on the southeast side of the lake.	x	
		134	*Quercus falcata* Michx. (Southern Red Oak)	5		T	Frequent on both sides of the lake.	x	x
		135	*[1]Quercus marilandica* Munchh. (Blackjack Oak)	5	S		Infrequent on the southeast side of the lake.	x	x
		136	*Quercus nigra* L. (Water Oak)	2		T	Scattered on both sides of the lake, near the water.	x	x
		137	*Quercus phellos* L. (Willow Oak)	3		R	Scattered on both sides of the lake.	x	x
		138	*Quercus rubra* L. (Northern Red Oak)	3		T	Common on both sides of the lake.	x	x
		139	*Quercus stellata* Wangenh. (Post Oak)	3		T	Scattered on both sides of the lake.	x	
		140	*Quercus velutina* Lam. (Black Oak)	5	S		Common on the southeast side.	x	x

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
35	Gentianaceae	141	*Gentiana quinquefolia* (L.) Small ssp. *quinquefolia* (Agueweed)	3	N		Rich woods of the northeast side and northern slopes above the lake.	x	
		142	*Gentiana saponaria* L. (Harvestbells)	2	W		Frequent, along the water on the southwest side.	x	
		143	*Obolaria virginica* L. (Virginia Pennywort)	3	E		Frequent, along creeks and trails of the east side.	x	
		144	*Sabatia angularis* (L.) Pursh (Rosepink)	2	W		Infrequent, at the west dam area and at Willow Springs.	x	
36	Geraniaceae	145	*Geranium maculatum* L. (Spotted Geranium)	3		T	Frequent, on west side of the lake.	x	x
37	Grossulariaceae	146	*Itea virginica* L. (Virginia Sweetspire)	2	N		Common on the north end on both sides of the lake along the water.	x	
38	Haloragaceae	147	*[1]*Myriophyllum aquaticum* (Vell.) Verdc. (Parrot Feather Watermilfoil)	1	N		Along marsh of Six Mile Creek in water of lake.	x	
39	Hamamelidaceae	148	*Liquidambar styraciflua* L. (Sweetgum)	3		T	Scattered in rich woods all around the lake.	x	x
40	Hippocastanaceae	149	*Aesculus sylvatica W.* Bartram (Painted Buckeye)	3		T	Scattered throughout the area.	x	x
		150	**Hydrangea arborescens* L. (Wild Hydrangea)	3		T	Frequent all around the lake.	x	
41	Iridaceae	151	*Iris verna* L. (Dwarf Violet Iris)	3	E		Rich woods on the northeast side of the lake and a northern ridge above the lake.	x	
		152	*Sisyrinchium angustifolium* Mill. (Narrowleaf Blue-Eyed Grass)	7	W		Along disturbed area on midwest side of the lake.	x	
		153	*Sisyrinchium mucronatum* Michx. (Needletip Blue-Eyed Grass)	5		T	South-facing slopes on both sides of the lake.	x	
42	Juglandaceae	154	*Carya alba* (L.) Nutt. (Mockernut Hickory)	3		T	Common all around the lake.	x	x
		155	*Carya glabra* (Mill.) Sweet (Pignut Hickory)	3	S		Scattered on the south side of the lake.	x	x
		156	**[1]Carya ovalis* (Wangenh.) Sarg. (Red Hickory)		S		Located on the southwest side at the dam.	x	
		157	*Juglans cinerea* L. (Butternut)	3	N		Rich woods on the northeast side of the lake and Holly Springs.	x	
43	Juncaceae	158	*Juncus effusus L.* (Common Rush)	2	E		Along the edge of the water, east side.	x	
		159	*Luzula acuminata* Raf. (Hairy Woodrush)				Rich woods on the east side of the lake.	x	

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		160	*Luzula echinata* (Small) F.J. Herm. (Hedgehog Woodrush)	3	E		Rich woods on the east side of the lake.	x	
44	Laminaceae	161	*Collinsonia canadensis* L. (Richweed)	3	W		Infrequent, in moist areas of the marsh and near the dam.	x	x
		162	*Lycopus virginicus* L. (Virginia Water Horehound)	1	N,W		Moist areas of the west dam and marsh of Six Mile Creek.	x	
		163	*Prunella vulgaris* L. (Common Selfheal)	5		T	Common, throughout the area.	x	
		164	**Pycnanthemum montanum* Michaux (Mountain Mint)	5	W		Infrequent, at the west dam area.	x	
		165	*Salvia lyrata* L. (Lyreleaf Sage)	5	W,N		Frequent, on the west side and on northern slopes above the lake.	x	x
		166	**Salvia urticifolia* L. (Nettleleaf Sage)	5	W,N		Frequent, on the west side and on northern slopes.	x	
		167	*Scutellaria elliptica* Muhl. ex Spreng. (Hairy Skullcap)	3	W		Infrequent, on the northwest side of the lake.	x	x
45	Lauraceae	168	*Lindera benzoin* (L.) Blume (Northern Spicebush)	3		T	Moist coves on both sides of the lake and at Indian Creek Nature Trail.	x	
		169	*Sassafras albidum* (Nutt.) Nees (Sassafras)	3		T	Infrequent, only small shrubs on east side and northern slopes.	x	x
46	Liliaceae	170	**Amianthium muscitoxicum* (Walter) A. Gray (Flypoison)	3	E		Rich woods on the northeast side of the lake.	x	x
		171	**Chamaelirium luteum* (L.) A. Gray (Fairywand)	3	E,N		Rich woods of the northern slopes and Indian Creek Nature Trail.	x	x
		172	*Erythronium americanum* Ker Gawl. (Dogtooth Violet)	3	E		Moist cove on the mideast side of the lake.	x	
		173	*Maianthemum racemosum* (L.) Link ssp. *racemosum* (Feathery False Lily of the Valley)	3		T	Rich woods all around the lake.	x	x
		174	*Polygonatum biflorum* (Walter) Elliott (Smooth Solomon's Seal)	3		T	Rich woods all around the lake.	x	x
		175	*Trillium catesbaei* Elliott (Bashful Wakerobin)	3		T	Rich woods all around the lake.	x	x
		176	*Trillium discolor* Wray ex Hook. (Mottled Wakerobin)	3		T	Moist coves on both sides of the lake.	x	

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		177	*Uvularia perfoliata* L.(Perfoliate Bellwort)	3		T	Rich woods of the northern slopes around Wildcat Creek, Indian Creek Nature Trail, and the trails on the northeast side of the lake.	x	x
47	Linaceae	178	*Linum striatum* Walter (Ridged Yellow Flax)	2	E		Frequent, along the water on the Mideast to northwest side of the lake, and in the marsh of Six Mile Creek.	x	x
48	Loganiaceae	179	*Spigelia marilandica* (L.) L. (Woodland Pinkroot)	3		T	Common, throughout the area.	x	x
49	Lycopodiaceae	180	*Lycopodium digitatum* Dill. Ex. A. Braun (Fan Clubmoss)	4		R	Rare, in moist pine forest on north end of the lake.	x	
50	Lythraceae	181	*Lagerstroemia indica* L. (Crapemyrtle)	5	S		East side of the lake.	x	
		182	*[1]*Rotala ramosior* (L.) Koehne (Lowland Rotala)	2	W		Near water on the southwest side of the lake.	x	
51	Magnoliaceae	183	**Liriodendron tulipifera* L. (Tuliptree)	3		T	Common in most coves on both sides of the lake, and in pure stand along Six Mile Creek flood plain.	x	
		184	*Magnolia acuminata* (L.) L. (Cucumber-Tree)	3		T	Scattered in moist coves on both sides of the lake but diminishing in number due to beaver damage.	x	
52	Melastomataceae	185	*Rhexia virginica* L. (Handsome Harry)	1	N		Marsh of Six Mile Creek and on the southeast side of the lake.	x	
53	Menispermaceae	186	*Cocculus carolinus* (L.) DC. (Carolina Coralbead)	3	E		Rich woods on the northwest side of the lake.	x	x
54	Monotropaceae	187	[1]*Monotropa hypopithys* L. (Pinesap)	3	E	R	On the northeast side at the base of a Beech tree.	x	
		188	[1]*Monotropa uniflora* L. (Indianpipe)	3	S	R	On the southeast side near the dam.	x	x
55	Moraceae	189	**Morus rubra* L. (Red Mulberry)	3		T	Scattered throughout the area.	x	x
56	Oleaceae	190	*Chionanthus virginicus* L. (White Fringetree)	3		T	Infrequent, on both sides and northern slopes.	x	
		191	**Fraxinus americana* L. (White Ash)	3		T	Infrequent, on both sides of the lake.	x	
		192	*[1]*Fraxinus pennsylvanica* Marshall (Green Ash)	3	E	R	On the northeast side.	x	x
		193	*Ligustrum sinense* Lour. (Chinese Privet)	7		T	Scattered all around the lake, and abundant in the marsh of Six Mile Creek.	x	

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
57	Ophioglossaceae	194	[1]*Botrychium virginianum* (L.) Sw. (Rattlesnake Fern)	3	N		Rich woods on north end of the lake.	x	x
58	Orchidaceae	195	*Corallorhiza odontorhiza* (Willd.) Poir. (Autumn Coralroot)	5	E		Along trails on the mideast side of the lake.	x	
		196	**Cypripedium parviflorum* Salisb.var. *pubescens* (Willd.) Knight (Greater Yellow Lady's Slipper)	3	S, N		Rich slopes on the northern end of the lake.	x	
		197	*Goodyera pubescens* (Willd.) R. Br. (Downy Rattlesnake Plantain)	3		T	Rich woods all around the lake and at Indian Creek.	x	x
		198	*Platanthera clavellata* (Michx.) Luer (Small Green Wood Orchid)	3	N		Rich woods on the northwest side and at Wildcat Creek.	x	
		199	*Tipularia discolor* (Pursh) Nutt. (Crippled Cranefly)	3	S		Along trails on the southeast side of the lake and on a northern ridge above the lake.	x	x
59	Orobanchaceae	200	*Epifagus virginiana* (L.) W.P.C. Barton (Beechdrops)	3	E		Frequent, on the east side under beech trees.	x	x
60	Papaveraceae	201	*Sanguinaria canadensis* L. (Bloodroot)	5		T	Common on south-facing slopes on both sides of the lake.	x	x
61	Pinaceae	202	* *Pinus echinata* Mill. (Shortleaf Pine)	5		T	Common, scattered all around the lake.	x	x
		203	**Pinus elliottii* Engelm. (Slash Pine)	4	N		(Planted) Scattered on the northwest side.	x	
		204	*Pinus palustris* Mill. (Longleaf Pine)	4	N	R	Planted on the northwest side of the lake.	x	
		205	*Pinus strobus* L. (Eastern White Pine)	4	E,W		Planted on both sides of the lake.	x	x
		206	**Pinus taeda* L. (Loblolly Pine)	4	N		Plantations on the north end and northwest side of the lake.	x	x
		207	*Tsuga canadensis* (L.) Carriere (Eastern Hemlock)	3	W	R	Rare, moist woods on midwest side.	x	
62	Platanaceae	208	*Platanus occidentalis* L. (American Sycamore)	1	N		Moist areas along the dam, at Indian Creek, and in the marsh of Six Mile Creek.	x	
63	Poaceae	209	*Agrostis stolonifera* L. (Creeping Bentgrass)	3	E,S	R	In rich woods of Indian Creek Nature Trail and the southwest side of the dam.	x	
		210	*[1]*Arthraxon hispidus* (Thunb.) Makino (Small Carpgrass)	7	W	R	In disturbed area on midwest side.	x	
		212	*Arundinaria gigantea* (Walter) Muhl. (Giant Cane)	5		T	Dry woods throughout.	x	

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		213	*Chasmanthium latifolium* (Michx.) Yates (Indian Woodoats)	2		T	Common along the edge of the water.	x	x
		214	*Chasmanthium sessiliflorum* (Poir.) Yates (Longleaf Woodoats)	3		T	Marsh areas and dry woods.	x	x
		215	[1]*Dichanthelium boscii* (Poir.) Gould & C.A. Clark (Bosc's Panicgrass)	3	W		Along nature trail on the west side of the lake.	x	x
		216	[1]*Dichanthelium commutatum* (Schult.) Gould (Variable Panicgrass)	7	W	R	In disturbed area on the midwest side of the lake.	x	x
		217	*Elymus virginicus* L. (Virginia Wildrye)	5	W		Dry woods on the west side.	x	x
		218	*Melica mutica* Walter (Twoflower Melicgrass)	5	W		Dry woods on the west side.	x	
		219	*Piptochaetium avenaceum* (L.) Parodi (Blackseed Speargrass)	5	S		Dry woods on the southwest side.	x	
		220	**Poa chapmaniana* Schribn. (Chapman's Bluegrass)	7		T	Scattered on both sides of the lake.	x	
		221	*[1]*Sorghastrum nutans* (L.) Nash (Indiangrass)	5	S	R	On the southeast side of the dam.	x	
64	Polemoniaceae	222	*Phlox amoena* Sims (Hairy Phlox)	3	W		Rich woods on the west side and northern slopes.	x	
65	Polygonaceae	223	*Rumex crispus* L. (Curly Dock)	7	W		Disturbed area on the midwest side of the lake.	x	
66	Polypodiaceae	224	*Pleopeltis polypodioides* (L.) Andrews & Windam ssp. *polypodioides* (Resurrection Fern)	3	E,W		Scattered on both sides of the lake.	x	x
67	Primulaceae	225	*Lysimachia quadrifolia* L. (Whorled Yellow Loosestrife)	3	N		Rich woods on both sides of the dam and at Wildcat Creek.	x	x
68	Pteridaceae	226	*Adiantum pedatum* L. (Northern Maidenhair)	3	E,W		Common in rich woods on northern slopes and both east and west sides of the lake.	x	x
69	Pyrolaceae	227	*Chimaphila maculata* (L.) Pursh (Striped Prince's Pine)	3		T	Frequent, throughout the area.	x	x
70	Ranunculaceae	228	*Aconitum uncinatum* L. (Southern Blue Monkshood)	3	N		Moist coves on the northeast and midwest sides of the lake.	x	x
		229	*Actaea racemosa* L. var. *racemosa* (Black Bugbane)	3		T	Rich woods on both sides of the lake.	x	x

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		230	**Anemone lancifolia* Pursh (Mountain Thimbleweed)	3		T	Rich woods on both sides of the lake.	x	
		231	*Anemone virginiana* L. (Tall Thimbleweed)	3		T	Rich woods on both sides of the lake.	x	
		232	**Clematis viorna* L. (Vasevine)	3		T	Rich woods on the west side of the lake and northern slopes above the lake.	x	
		233	**Hepatica nobilis* Schreb.var. *obtusa* (Prush) Steyerm. (Roundlobe Hepatica)	3		T	North-facing slopes on both sides.	x	x
		234	**Thalictrum thalictroides* (L.) Eames & B. Boivin (Rue Anemone)	3		T	Rich woods on both sides of the lake.	x	x
		235	*Xanthorhiza simplicissima* Marshall (Yellowroot)	2		T	Scattered along the edge of the lake and Indian Creek.	x	
71	Rhamnaceae	236	*Ceanothus americanus* L. (New Jersey Tea)	3	N		Scattered throughout the area.	x	x
72	Rosaceae	237	**Agrimonia gryposepala* Wallr. (Tall Hairy Agrimony)	3		T	Scattered on both sides of the lake.	x	
		238	*Amelanchier arborea* (Michx. F.) Fernald (Common Serviceberry)	3	E		Infrequent, on moist slopes of the east side.	x	x
		239	*Crataegus uniflora* Muenchh. (Dwarf Hawthorn)	5		T	Common throughout the area.	x	x
		240	**Duchesnea indica* (Andrews) Focke (Indian Strawberry)	3	N	R	In rich woods on the west side.	x	
		241	*Photinia pyrifolia* (Lam.) K.R. Roberson & Phipps (Red Chokeberry)	2	E		Frequent, along the water on the mideast side.	x	
		242	**Prunus americana* Marshall (American Plum)	3	E		Infrequent, on the east side at the dam.	x	
		243	*Prunus serotina* Ehrh. (Black Cherry)	5	N		Infrequent, on both sides on the northern portion of the lake and on northern slopes above the lake.	x	x
		244	*Rosa carolina* L. (Carolina Rose)	5	E		South-facing slopes on the northeast side.	x	x
		245	**Rosa multiflora* Thunb. (Multiflora Rose)	6	W		Frequent on roadsides and scattered on the west side of the lake.	x	
73	Rubiaceae	246	*Cephalanthus occidentalis* L. (Common Buttonbush)	2	W		Marsh of Six Mile Creek and along the water at the dam.	x	
		247	*Diodia virginiana* L. (Virginia Buttonweed)	2	W		Marsh of Six Mile Creek and along the water at the dam.	x	

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
		248	*Galium pilosum* Aiton (Hairy Bedstraw)	3	E		Frequent, in rich woods of the northeast side, Indian Creek and Wildcat Creek.	x	x
		249	[1]*Galium triflorum* Michx. (Fragrant Bedstraw)	3	W	R	In moist cove on the southwest side.	x	x
		250	[1]*Houstonia caerulea* L. (Azure Bluet)				Rare, along Rhododendron thicket at the southeast dam area.	x	
		251	*Houstonia longifolia* Gaertn. (Longleaf Summer Bluet)	3		T	Frequent, on both sides of the lake.	x	x
74	Saxifragaceae	252	*Heuchera americana* L. (American Alumroot)	3	N		Along trails on both sides of the lake on the north end.	x	
75	Scrophulariaceae	253	*Aureolaria laevigata* (Raf.) Raf. (Entireleaf Yellow False Foxglove)	3		T	Common, throughout the area.	x	x
		254	*Chelone glabra* L. (White Turtlehead)	2	W		Infrequent, along water on the west side.	x	
		255	*Penstemon australis* Small (Eustis Lake Beardtongue)	3	W		Infrequent, on the west side.	x	
		256	*Penstemon laevigatus* Aiton (Eastern Smooth Beardtongue)	3		T	Infrequent, in rich woods on both sides.	x	
76	Selaginellaceae	257	*Selaginella apoda* (L.) Spring (Meadow Spikemoss)	2		T	Common along the banks of the lake.	x	
77	Smilacaceae	258	*Smilax glauca* Walter (Cat Greenbrier)	3	N		Rich woods on the west side of the dam.	x	x
		259	*Smilax rotundifolia* L. (Roundleaf Greenbrier)	3	N		Rich woods of northern slopes.	x	
78	Solanaceae	260	*Physalis virginiana* Mill. (Virginia Ground Cherry)	3	W,N		Infrequent, on the northwest side and on northern slopes.	x	x
		261	[1]*Solanum carolinense* L. (Carolina Horsenettle)	5	W	R	At the west dam area.	x	
79	Staphyleaceae	262	*Staphylea trifolia* L. (American Bladdernut)	3	E		Infrequent, along path of northeast side.	x	
80	Styracaceae	263	*Halesia carolina* L. (Carolina Silverbell)	3	E		Rich woods on the northeast side and marsh of Six Mile Creek.	x	
		264	**Styrax americanus* Lam. (American Snowbell)	3	W	R	On the edge of the water on the west side.	x	
		265	**Styrax grandifolius* Aiton (Bigleaf Snowbell)	3	W		Infrequent, on the midwest side of the lake.	x	
81	Symplocaceae	266	*Symplocos tinctoria* (L.) L'Her. (Common Sweetleaf)	3	E		Infrequent, rich woods on the northeast side of the lake.	x	x

No.	Family	No.	Species (Common Name)	H	L	O	Habitat	1970-1971	2011-2012
82	Thelypteridaceae	267	*Phegopteris hexagonoptera* (Michx.) Fee (Broad Beechfern)	3	E,W		Rich woods on the east side of the lake and at Willow Springs.	x	x
		268	*Thelypteris noveboracensis* (L.) Nieuwl. (New York Fern)	3	N		Rich woods on the north end.	x	
83	Tiliaceae	269	*Tilia americana* L. var. *heterophylla* (Vent.) Loudon (American Basswood)	3	E		Rich woods on the northeast side of the lake.	x	
		270	**Tilia americana* L. var. *caroliniana* (Mill.) Castigl. (Carolina Basswood)				Infrequent, in rich woods of the northwest side of the lake.	x	
84	Ulmaceae	271	**Celtis tenuifolia* Nutt. (Dwarf Hackberry)	3		T	Scattered on both sides of the lake.	x	
		272	*Ulmus alata* Michx. (Winged Elm)	3	E		Scattered in rich woods of the east side.	x	x
85	Valerianaceae	273	*Valerianella radiata* (L.) Dufr. (Beaked Corn Salad)	5	W		Infrequent, at old boathouse site and south-facing northern slope.	x	
86	Verbenaceae	274	*Callicarpa americana* L. (American Beautyberry)	3	E		Infrequent, on the northeast side.	x	
87	Violaceae	275	*Viola hastata* Michx. (Halberdleaf Yellow Violet)	3	E		Frequent on the east side and Wildcat Creek.	x	x
		276	*[1]*Viola sagittata* Aiton var. *sagittata* (Arrowleaf Violet)	5	E		Along trails on the southeast side.	x	
		277	*Viola triloba* Schwein.var. *triloba* (Three-Lobe Violet)	3	W		Frequent on the west side and on the northern slopes above the lake.	x	
		278	**Viola walteri* House (Prostrate Blue Violet)	3		T	Common on both sides of the lake.	x	x
88	Vitaceae	279	*Parthenocissus quinquefolia* (L.) Planch. (Virginia Creeper)	3	W		Marsh of Six Mile Creek and west dam area.	x	x
		280	*Vitis aestivalis* Michx. (Summer Grape)	3	W		Moist coves on the west side and trails at Indian Creek.	x	
		281	*Vitis rotundifolia* Michx. (Muscadine)	3		T	Common on both sides of the lake.	x	x

Table 6. Comparison between blooming charts in 1970-1971 (Symbol:•) and 2011-2012 (Symbol :◊).

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Acer rubrum	√	√	√		◊	• ◊									
Aconitum uncinatum	√												•		
Actaea racemosa var. race	√	√	√					◊	◊	•					
Aesculus sylvatica	√	√	√			◊	•◊								
Agalinis purpurea		√										◊			
Ageratina altissima	√	√	√								◊	•◊	◊	◊	
Ageratina aromatica	√											•			
Agrimonia pubescens	√	√	√							•◊	◊				
Alnus serrulata	√	√	√		◊	•									
Allium cernuum		√								◊	◊				
Ambrosia artemisiifolia	√											•			
Ambrosia trifida	√											•			
Amelanchier arborea	√					•									
Amianthium muscaetoxicum	√	√	√					•◊		•◊					
*Amphicarpaea bracteata***	√	√	√								◊	•◊			
Amsonia tabernaemontana	√						•								
Anemone lancifolia	√						•								
Anemone virginiana		√							◊						
Angelica venenosa	√									•					
Antennaria plantaginifolia	√	√	√			◊	•◊								
Antennaria solitaria	√						•								
Apios americana	√	√	√					◊	◊	•	◊	•			
Apocynum cannabinum	√							•							
Arisaema triphyllum		√					◊	◊							

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Arnoglossum atriplicifolium	√	√	√							•◊	◊	•◊	•		
Asclepias tuberosa	√	√	√					◊	•						
*Asclepias variegata***	√	√	√					•◊							
Asimina triloba		√				◊									
Aureolaria laevigata		√										◊			
Aureolaria virginica	√	√	√						◊	•◊	◊				
Baptisia alba	√	√	√				◊	◊	•◊						
Bidens frondosa	√	√	√									•◊			
*Bignonia capreolata***		√				◊	◊								
Boehmeria cylindrica	√										•				
Callicarpa americana	√	√	√							•	•	◊			
Calycanthus floridus	√	√	√				•◊	•							
Calystegia spithamaea		√					◊								
*Campanula divaricata***		√										◊	◊		
Campsis radicans	√								•	•					
Cardamine hirsuta	√					•									
Carpinus caroliniana	√						•								
Catalpa speciosa	√							•	•						
Ceanothus americanus	√	√	√					◊	•						
Centrosema virginianum	√	√	√						◊	•◊	•◊				
Cephalanthus occidentalis	√	√	√						◊	•◊	◊				
Cercis canadensis	√	√	√			◊	•								
Chamaecrista fasciculata	√	√	√							•◊	•◊				
Chamaecrista nictitans	√	√	√								◊	•◊			
Chamaelirium luteum	√	√	√				•◊	•							
Chamaesyce maculata	√											•			

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Chelone glabra	√	√	√									◊	•◊		
Chimaphila maculata	√	√	√					◊	•◊						
Chionanthus virginicus	√						•								
Chrysogonum virginianum	√	√	√		◊	◊	•◊	•◊							
Chrysopsis mariana	√	√	√								◊	•◊	◊	◊	◊
Cicuta maculata		√							◊	◊	◊				
Cirsium altissimum	√											•			
Clematis viorna	√	√	√				◊	•	•						
Clematis virginiana	√	√	√								•◊				
Clitoria mariana	√	√	√					◊	◊	•◊	◊				
Collinsonia canadensis	√											•	•		
Commelina communis		√								◊	◊	◊			
Commelina virginica		√									◊				
Coreopsis lanceolata		√					◊	◊							
Coreopsis major	√	√	√					◊	◊	•◊	◊	◊			
Cornus amomum	√							•							
Cornus florida	√	√	√			◊	•								
Cornus foemina		√									◊				
Corylus americana	√					•									
Crataegus uniflora	√							•							
Croptilon divaricatum	√											•			
Crotalaria sagittalis	√	√	√						◊	•					
Cuscuta compacta	√									•		•			
Cynoglossum virginianum	√						•	•							
Cypripedium acaule	√						•	•							
Cypripedium parviflorum	√							•							

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Daucus carota	√								•	•					
Daucus pusillus	√									•					
Decumaria barbara	√								•						
Desmondium canescens	√											•			
Desmodium nudiflorum		√							◊	◊	◊				
Desmodium rotundifolium	√	√	√					◊	◊		◊	•◊			
Diodia teres	√	√	√							•	◊				
Diodia virginiana	√	√	√					◊	•◊	•◊	◊	◊			
Dioscorea villosa	√							•							
Doellingeria infirma	√	√	√						◊	•◊	◊				
Duchesnea indica	√					•									
Eclipta prostrata	√											•			
Elephantopus carolinianus	√	√	√									•◊			
Elephantopus tomentosus	√	√	√							◊	◊	•◊			
Epifagus virginiana	√	√	√								◊	•◊	◊		
Epigaea repens	√	√	√			• ◊									
Erigeron pulchellus	√	√	√			◊	•◊	•							
Erigeron strigosus	√	√	√					•◊	•◊	◊	◊	•			
Erythronium americanum	√	√	√			•◊									
Euonymus americanus	√	√	√				◊	•							
Eupatorium album		√								◊	◊				
Eupatorium capillifolium	√											•			
Euphorbia corollata	√	√	√				◊	•◊	•◊	•◊	◊	◊			
Eutrochium fistulosum	√										•	•			
Fagus grandifolia	√	√	√			◊	•								
Fragaria virginiana	√						•								

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Galax urceolata	√	√	√				◊	•◊							
Gentiana saponaria	√	√	√									◊	•◊	◊	◊
Gentiana villosa		√										◊			
Gentianella quinquefolia	√	√	√										•◊		
Geranium carolinianum	√						•								
Geranium maculatum	√	√	√			◊	•◊	•							
Gillenia trifoliata	√	√	√				•◊	•							
Glycine max	√									•	•				
Goodyera pubescens	√	√	√							•◊					
Halesia carolina	√						•								
Halesia tetraptera		√				◊									
Helenium amarum	√											•			
Helianthus atrorubens	√								•			•			
Helianthus decapetalus	√										•				
Helianthus divaricatus	√									•					
Helianthus hirsutus	√									•					
Helianthus strumosus	√											•			
Hemerocallis fulva	√								•						
Hepatica nobilis var. obtu	√	√	√		◊	•	◊								◊
Heterotheca subaxillaris	√											•			
Heuchera americana	√	√	√				◊	•							
Hexastylis arifolia	√	√	√			◊	•◊	◊							
Hexastylis heterophylla		√				◊	◊	◊							
Hexastylis minor	√						•								
Hieracium venosum	√	√	√			◊	•◊	•◊	◊	◊			◊		
Houstonia caerulea	√	√	√			• ◊	•◊	◊							

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Houstonia longifolia	√	√	√				◊	•◊	•◊	◊	◊				
Hydrangea arborescens	√							•	•						
Hypericum hypericoides		√								◊	◊	◊			
Hypericum mutilum	√	√	√							•◊	◊				
Hypericum punctatum		√							◊	◊	◊				
Hypoxis hirsuta	√	√	√			◊	◊	•◊	◊	◊	◊	◊			
Ilex opaca	√							•							
Ilex verticillata	√							•							
Impatiens capensis	√	√	√							•◊	◊	•◊			
Ionactis linariifolius	√											•			
Ipomoea hederacea		√										◊			
Ipomoea pandurata	√	√	√						◊	•◊	◊				
Iris verna	√	√	√			◊	•								
Itea virginica	√	√	√				◊	•	•						
Kalmia latifolia	√	√	√				◊	•◊							
Lathyrus venosus	√	√	√			◊	•								
Leucothoe fontanesiana		√				◊	◊								
*Lespedeza cuneata**	√	√	√						◊	◊	•◊	◊			
Lespedeza intermedia	√									•		•			
Lespedeza repens	√								•		•				
Leucanthemum vulgare	√	√	√					•◊	•◊	•◊					
Leucothoe axillaris	√							•							
Ligusticum canadense		√						◊							
Ligustrum sinense	√							•	•						
Lindera benzoin	√					•									
Lindernia dubia	√									•					

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Linum striatum	√	√	√						◊	•◊					
Liriodendron tulipifera		√					◊								
*Lobelia cardinalis***	√	√	√							◊	◊	◊	•		
*Lobelia inflata***	√	√	√						◊	•◊	◊				
Lobelia puberula	√	√	√								◊	•◊	•◊		
Lobelia spicata	√	√	√					◊	◊	•◊	•				
Lonicera japonica	√	√	√				◊	•							
Lonicera sempervirens	√	√	√			◊	•	•◊							
Ludwigia alternifolia		√							◊		◊	◊			
Ludwigia leptocarpa		√									◊	◊	◊		
Lyonia ligustrina	√							•							
Lysimachia quadrifolia	√	√	√					•◊							
Maianthemum racemosum	√	√	√				•◊	•							
Malus pumila	√						•								
Matelea carolinensis	√	√	√				◊	•							
Mikania scandens		√									◊	◊			
Mimosa microphylla	√	√	√					◊	•◊	•◊	◊				
Mimulus ringens	√	√	√							•◊	◊	•			
Mitchella repens	√	√	√				◊	•							
Mollugo verticillata	√									•					
*Monotropa hypopithys***	√	√	√					◊				•◊			
*Monotropa uniflora***	√	√	√									•◊			
Nestronia umbellula	√							•							
Nuphar lutea	√	√	√			◊	•◊			◊	◊	◊	◊		
Nuttallanthus canadensis		√				◊	◊								
Obolaria virginica	√					•	•								

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Oenothera biennis	√										•				
Oenothera fruticosa ssp. gl	√							•	•						
Oenothera laciniata	√						•								
Onosmodium virginianum	√							•							
Orbexilum onobrychis	√											•			
Oxalis corniculata	√								•						
Oxalis dillenii		√				◊	◊	◊					◊	◊	
Oxalis stricta	√	√	√			◊	•◊								
Oxalis violacea	√	√	√			◊		•			◊	◊			
Oxydendrum arboreum		√							◊	◊					
*Oxypolis rigidior***	√	√	√									•◊			
Packera anonyma	√	√	√				◊	•							
Passiflora incarnata	√									•	•				
Pedicularis canadensis	√						•								
Peltandra virginica		√					◊	◊	◊						
Penstemon australis	√								•						
Penstemon digitalis		√						◊							
Penstemon laevigatus	√								•						
Phaseolus polystachios		√						◊	◊		◊				
Phlox amoena	√	√	√			◊	•◊	•◊							
Phlox glaberrima	√								•						
Phlox carolina		√						◊	◊	◊					
Phlox nivalis	√					•	•								
Phryma leptostachya	√									•					
Physalis virginiana	√	√	√				◊	•			◊				
Pityopsis graminifolia	√	√	√							◊	◊	•◊	◊		

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Plantago virginica	√						•	•							
Platanthera clavellata	√	√	√							•◊	•				
Podophyllum peltatum	√	√	√			◊	•								
Polygala senega	√						•								
Polygonatum biflorum	√	√	√				◊	•							
Polygonum pensylvanicum	√	√	√									•◊	•◊	◊	
Polygonum sagittatum	√	√	√							◊	◊	•◊	◊		
Polygonum setaceum	√	√	√								◊	•◊			
Potentilla canadensis	√	√	√			◊	•◊								
Prunella vulgaris	√	√	√				•	•	•	•◊	•◊	◊			
Prunus americana	√						•								
Prunus dulcis	√					•									
Prunus persica	√					•									
Prunus serotina	√						•								
Pseudognaphalium obtusifo	√	√	√									•◊	◊		
Pueraria montana	√										•				
Pycnanthemum incanum		√							◊	◊	◊	◊			
Pycnanthemum montanum	√									•		•			
Pyrrhopappus carolinianus	√									•					
Ranunculus acris		√				◊	◊								
Ranunculus hispidus	√	√	√			◊	•								
Rhexia mariana		√						◊	◊	◊	◊				
Rhexia virginica	√	√	√						◊	◊	•◊	◊			
Rhododendron arborescens	√								•						
Rhododendron minus	√	√	√				◊	•◊						◊	◊
Rhododendron periclymeno	√	√	√			◊	•◊								

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Rhus copallinum	√									•					
Rhus glabra	√								•						
Rosa multiflora	√	√	√				◊	•◊							
Rubus laudatus		√					◊								
Rudbeckia fulgida	√											•			
Rudbeckia hirta	√	√	√					◊	•◊	•◊			◊		
Rudbeckia laciniata	√									•		•			
Ruellia caroliniensis	√	√	√				◊	◊	•◊	•◊					
Rumex crispus	√							•							
Sabatia angularis	√	√	√							•◊					
Sagittaria latifolia		√									◊	◊			
Salix sericea	√						•								
Salvia lyrata	√	√	√			◊	•◊	•							
Salvia urticifolia	√	√	√				•◊	•							
Sambucus nigra ssp. canad	√								•						
Sanicula canadensis		√					◊	◊	◊						
Sanguinaria canadensis	√					•	•								
Scutellaria elliptica	√	√	√					•◊	•◊						
Scutellaria integrifolia		√						◊	◊						
Scutellaria lateriflora		√									◊				
Senna obtusifolia	√	√	√								•◊	◊	◊		
Sericocarpus asteroides	√	√	√						◊	•◊					
Sericocarpus linifolius	√								•						
Silene stellata	√	√	√						◊	◊	•◊	◊			
Silene virginica	√	√	√			◊	•◊	•◊	◊						
Silphium asteriscus var. la	√								•						

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Sisyrinchium angustifolium	√	√	√			◊	•◊	•◊	◊						
Sisyrinchium mucronatum	√						•								
Smallanthus uvedalius	√	√	√							◊	◊	•◊			
Smilax herbacea	√							•							
Smilax rotundifolia	√							•							
Solanum americanum	√										•				
*Solanum carolinense***	√	√	√					◊	•		◊	◊			
Solidago arguta	√	√	√						◊	•					
Solidago caesia	√											•			
Solidago curtisii	√											•			
Solidago erecta	√	√	√						◊			•			
Solidago odora	√	√	√						◊	◊	◊	•			
Spigelia marilandica	√	√	√					•◊	•◊						
Spiranthes lacera var. grac		√							◊						
Staphylea trifolia	√						•								
Stellaria pubera	√	√	√			◊	•◊								
Stylosanthes biflora	√	√	√					◊	◊	•◊	◊	◊			
*Styrax grandifolius***	√	√	√				◊	•							
Symphyotrichum cordifoli	√											•			
Symphyotrichum patens		√										◊	◊		
Symphyotrichum pilosum	√	√	√									•◊	◊	◊	
Symphyotrichum undulatu	√	√	√									•◊			
Symplocos tinctoria	√	√	√			◊	•								
Tephrosia spicata	√	√	√					◊	◊	•◊	◊				
Tephrosia virginiana	√	√	√			•	◊	◊							
Tipularia discolor		√								◊	◊				

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Thalictrum pubescens		√						◊	◊						
Thalictrum thalictroides	√	√	√			•◊	•◊								
Thaspium barbinode	√	√	√				•◊	•							
Thaspium trifoliatum	√							•							
Toxicodendron radicans	√							•							
Tradescantia subaspera		√					◊	◊	◊	◊	◊	◊			
Trifolium dubium	√							•							
Trillium catesbaei	√	√	√			◊	•◊	•							
Trillium discolor	√	√	√			◊	•◊	•							
Triodanis perfoliata	√							•							
Utricularia gibba	√											•			
Uvularia perfoliata	√						•								
Vaccinium arboreum	√	√	√				◊	•◊		◊					
Vaccinium angustifolium		√				◊									
Vaccinium pallidum	√	√	√			◊	•							◊	
Vaccinium stamineum	√	√	√				◊	•							
Valerianella radiata	√						•								
Veratrum latifolium		√							◊	◊	◊				
Verbascum thapsus	√	√	√							•◊					
Verbena urticifolia	√										•				
Verbesina alternifolia		√						◊		◊	◊	◊			
Verbesina occidentalis	√	√	√									•◊	◊		
Verbesina virginica	√	√	√							◊	•◊	◊			
Vernonia glauca	√									•					
Vernonia noveboracensis	√										•				
Vicia caroliniana	√	√	√			◊	•◊								

Species	1970-1971	2011-2012	Both periods	J	F	M	A	M	J	J	A	S	O	N	D
Vicia sativa ssp. nigra	√							•							
Viola hastata	√	√	√			• ◊	•								
Viola x palmata	√	√	√		◊	◊	•	•						◊	◊
Viola pedata	√					•	•								
Viola x primulifolia	√	√	√			◊	•◊								
Viola sororia		√				◊	◊								
Viola triloba		√				◊									
Viola walteri	√	√	√		◊	•◊	◊							◊	◊
Vitis aestivalis	√							•							
Vitis rotundifolia	√								•						
Wisteria frutescens		√				◊									
Xanthorhiza simplicissima	√	√	√			◊	•								
Yucca filamentosa	√								•						
Total (1970-1971):	269			0	0	21	69	73	39	55	23	55	9	0	0
Total (2011-2012):		203		0	6	53	68	57	56	62	70	57	21	10	6
Total (both periods, 1970-1971):			149	0	0	10	42	45	20	38	12	29	7	0	0
Total (both periods, 2011-2012):			149	0	6	41	52	42	38	47	49	41	17	10	6
* Invasive plants ** Rare plants															

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